Intended for

Highway Concessions One Pvt. Ltd

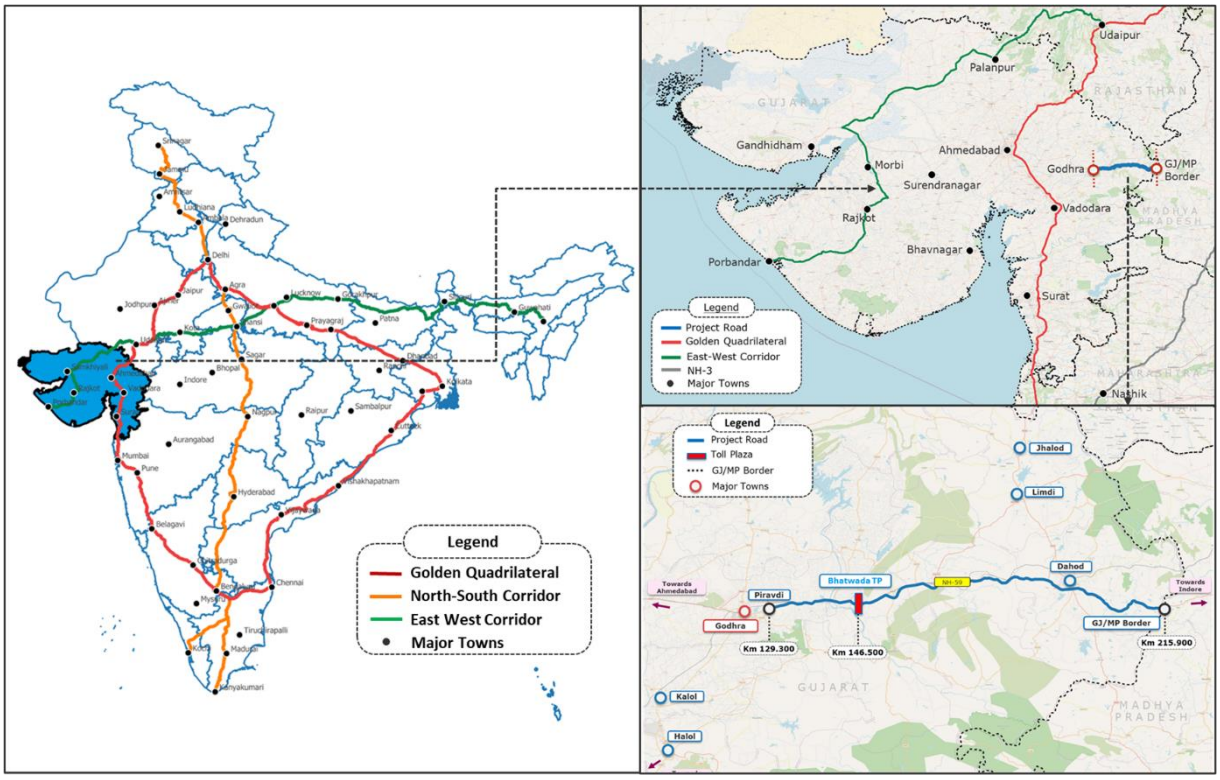
Document type

Traffic Study Report

Date

April 2023

TRAFFIC STUDY FOR GODHRA-GUJ/MP BORDER SECTION OF NH-59 IN THE STATE OF GUJARAT



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ABBREVIATIONS

$/US$/USD	United States Dollar
%	Percentage
₹/Rs	Indian Rupees
2A	2 Axle Truck
3A	3 Axle Truck
4A	4 Axle Trucks
5A	5 Axle Trucks
6A	6 Axle Trucks
AADT	Annual Average Daily Traffic
AR	Alternate Route
BIA	Broad Influence Area
BOT	Build, Operate & Transfer
CA	Concession Agreement
CAGR	Compounded Annual Growth Rate
CJV	Car/Jeep/Van
COVID	Corona Virus Disease
CR	Cost Ratio
CSO	Central Statistical Organisation
DBFOT	Design, Build, Finance, Operate & Transfer
DE	Check
DME	Delhi-Mumbai Expressway
DMIC	Delhi-Mumbai Industrial Corridor
DPA	Deendayal Port Authority
DPIIT	Department for Promotion of Industry and Internal Trade
DPR	Detailed Project Report
EI	Economic Indicator
EME	Earth Moving Equipment
FDI	Foreign Direct Investment
FY	Financial Year
GDP	Gross Domestic Product
GSDP	Gross State Domestic Product
GST	Goods & Services Tax
GVW	Gross Vehicle Weight
HCM	Heavy Construction Machinery
IE	Industrial Estates
IIA	Immediate Influence Area
IRC	Indian Roads Congress
IT	Information Technology
LCV	Light Commercial Vehicle

MAV	Multi Axle Vehicle
MBus	Mini-Bus
MLCV	Mini Light Commercial Vehicle
MORTH	Ministry of Road Transport and Highways
MP	Madhya Pradesh
MT	Metric Tonne
NH	National highway
NHAI	National Highway Authority of India
NHDP	National Highway Development Programme
OD	Origin & Destination
OSV	Oversized Vehicle
PCU	Passenger Car Unit
PIA	Project Influence Area
PIU	Project Implementation Unit
PPP	Public-Private Partnership
PR	Project Road
RBI	Reserve Bank of India
ROB	Road Over Bridge
RUCS	Road User Cost Study
SEZ	Special Economic Zone
SP	Special Publication
SPV	Special Purpose Vehicle
sq.km	Square Kilometre
TC	Toll Cost
TP	Toll Plaza
TTC	Travel Time Cost
US	United States of America
UT	Union Territory of India
VOC	Vehicle Operating Cost
WPI	Wholesale Price Index
WPR	Work participation rate
YOY	Year on Year

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1. INTRODUCTION

1.1 General

The project road, Godhra - Gujarat/MP Border, is part of NH-59 which starts at Piravdi near Godhra (km 129.300) and ends at the border of Gujarat with Madhya Pradesh (km 215.900) with a length of about 87.102 km. The project road as part of the upgradation of National Highways in India under NHDP Phase III was upgraded from 2-lane to 4-lane highway and was awarded to M/s Godhra Expressways Private Limited. which in turn formed a SPV Godhra Expressways Pvt. Ltd. The project is undertaken on DBFOT basis for a concession period of 27 years and tolling is operational at one existing toll plaza viz Bhatwada TP (km 146.500) since November 2013.

National Highway 59 (NH-59) connects Ahmedabad in Gujarat with Indore in Madhya Pradesh while passing through towns and cities such as Dhar, Dahod, Godhra, etc. It covers a distance of 350 km, of which 221 km is in Gujarat and 129 km is in Madhya Pradesh. NH-59 connects major economic centres like Ahmedabad, Vadodara, Kandla, Hazira, Rajkot etc. on the western side to places like Dahod, Pithampur, Indore, Bhopal etc. on the eastern side.

Figure 1-1 shows the alignment of NH-59 with major places along the highway.

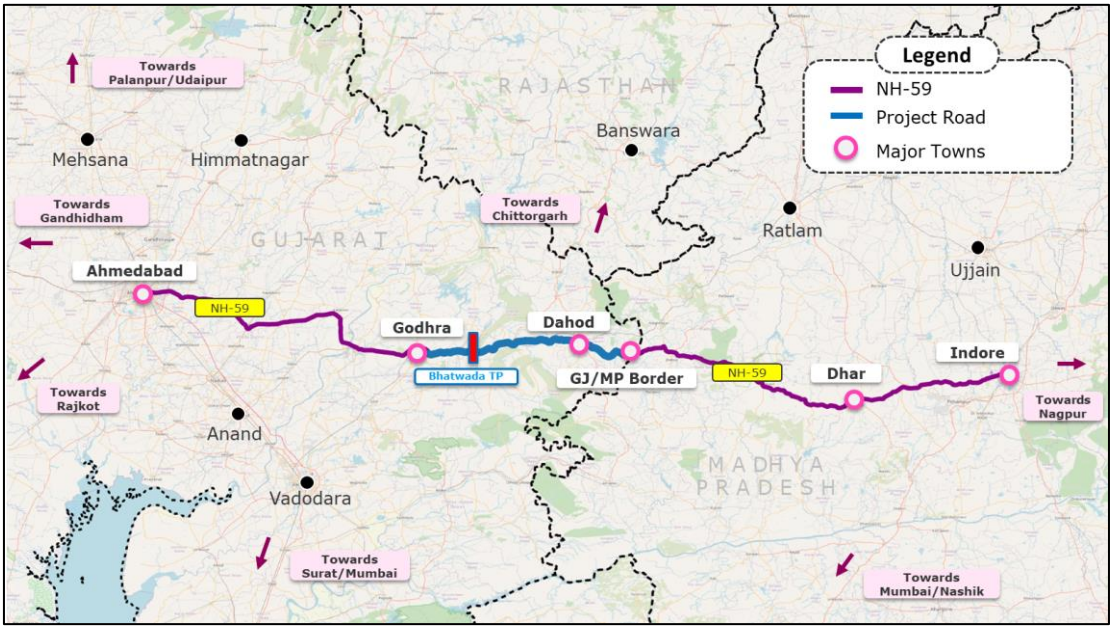


Figure 1-1: Alignment of NH-59 with Major Places

M/s. Ramboll India Private Ltd has been engaged as Traffic Consultant to carry out a study for assessing the present traffic levels, travel pattern and revenue estimation duly considering the network characteristics, future economic perspective in the influence area of the project and the provisions in the Concession Agreement of the project for the balance concession period.

1.2 Objective and Scope of Services

The objective of the study is to analyse the existing tollable traffic, travel pattern and to estimate the future traffic and toll revenue for the project road.

The scope of services includes preparation of a due diligence report for the project road covering the following:

- 1 day OD Survey at each toll plaza
- Analysis of recent toll/traffic data up to February 2023 and its growth trends
- Estimation of the base AADT for FY23
- Analysis of OD data to cover:
  - Trip matrix and influence factors for different zones contributing traffic on the corridor
  - Identification of Project Influence Area from analysis of travel pattern - regional distribution of traffic
  - Commodity composition- Goods type distribution
  - Top OD pairs by vehicle types
- To study the impact of traffic diversion (from/to project road) in present condition and future improved scenario, a cost ratio-based diversion analysis using spreadsheet-based modelling out for potential OD pairs
- Identify factors which may have a positive and / or negative impact on the traffic - all major developments like industrial corridors, freight corridor, economic corridors, ports, Bharatmala, Sagarmala
- Upcoming developments and future development potential of the region would be assessed for the induced/newly generated traffic
- Traffic projections for the balance concession period in three scenarios – low, most likely and high
- Toll revenue estimates using WPI forecasts and tolling ticket segmentation
- Scenario analysis of toll revenue

1.3 Report Structure

This report is divided into four chapters, including this introduction chapter. Chapter 2 details upon the project road characteristics and socio – economic profile of the districts in the project influence area including the estimation of AADT and travel characteristics in the Project Influence Area (PIA). Chapter 3 contains the details on the derivation of traffic growth rates used for traffic forecasting and presents traffic projections for the

study period. Chapter 4 presents the details regarding tolling strategy, toll rates and the revenue projections for the duration of the concession.

2. TRAFFIC SURVEY AND ANALYSIS

2.1 General

In order to understand the traffic characteristics, the travel pattern of vehicles plying on the project road were collected through primary surveys. This chapter presents the details of the project road characteristics, Annual Average Daily Traffic (AADT), travel characteristics on the project road. The results of the analysis will be utilized in assessing the traffic growth and estimation of traffic and revenue forecast on the project road for the concession period.

2.2 Project Road Characteristics

The project road, Godhra - Gujarat/MP Border, part of NH-59, starts at Piravdi near Godhra (km 129.300) and ends at the border of Gujarat with Madhya Pradesh (km 215.900) with a length of about 87.102 km. There is one existing toll plaza (Bhatwada TP) located at km 146.500 near Santrod.

The project road section falls under jurisdiction of Panchmahal and Dahod Districts in the State of Gujarat passing through the villages, viz., Santroad, Piplod, Limkheda and Dahod. The alignment of project road and toll plaza location is shown in **Figure 2-1**.

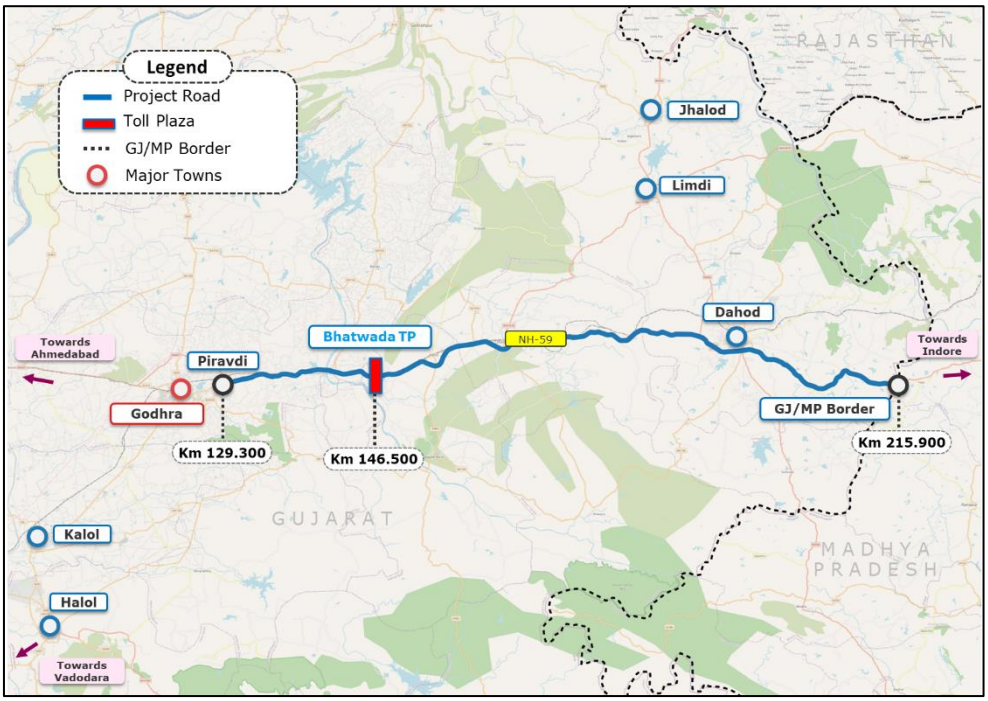


Figure 2-1: Project Road and Location of Toll Plaza

The project road, in wider context, serves the long-distance traffic which is majorly plying to/from Ahmedabad and beyond to Indore and beyond. Apart from long distance traffic, it also serves the short distance traffic which is mainly generated between Godhra and Dahod and surroundings.

2.2.1 Network characteristics in vicinity of the project road

The detail network assessment in the vicinity of the project section is presented in **Figure 2-2**.

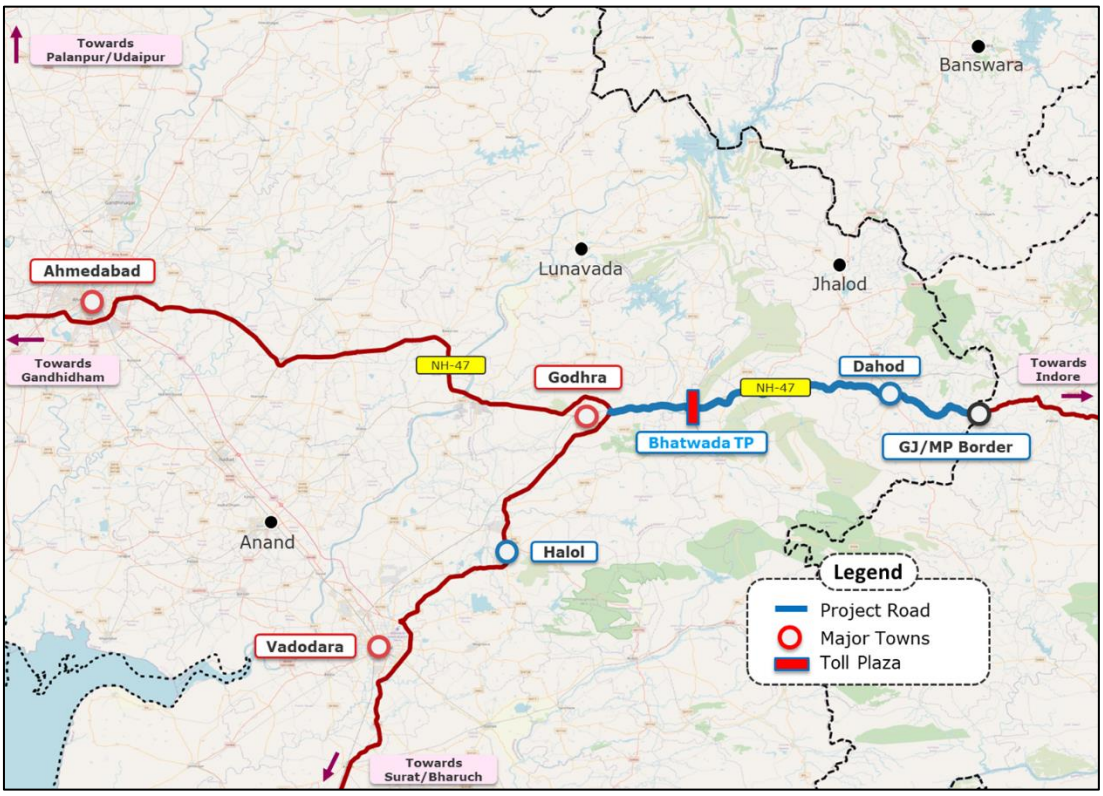


Figure 2-2: Network Characteristics in Vicinity of the Project Road

The project road section provides direct connectivity to/from the major economic centres like Ahmedabad, Vadodara, Kandla, Hazira, Rajkot etc. on the western side to places like industrial centres of Indore, Pithampur, Dhar, further to Dewas, Bhopal etc. on the eastern side.

From the network assessment, it is evident that the traffic from/to Ahmedabad/Rajkot/Surendranagar (west and central Gujarat) and beyond and the traffic from/to Vadodara/Surat/Hazira/Bharuch/Mumbai (South Gujarat and Maharashtra) & beyond enters the network at Godhra and travels the project section (NH-59) crossing Bhatwada TP which further travels to Indore/Ujjain/Dewas/Bhopal and beyond.

2.2.2 Profile of Project Influence Area

The project road solely lies in the state of Gujarat. Gujarat, one of the leading industrialized states of India, is located on the western coast of India and has the longest coastline of 1,600 km among all states in the country. It is considered the petroleum capital of India due to the presence of large refining capacity set up by private and public-sector companies. The state is the world's largest producer of processed diamonds, accounting for 72 per cent of the world's processed diamond share and 95 per cent of India's diamond exports. It is also the largest manufacturer of denim in the country and the third largest in the world. There are 42 ports, 18 domestic airports and one

international airport. The population of Gujarat State was 60.38 million according to 2011 census and the urban population accounts for around 42.6 percent.

The project road section falls under the district of Dahod district and Panchmahal District.

Dahod District

Dahod district is situated in the eastern part of Gujarat with an area of 3,943 sq.km. It is surrounded by the districts of Mahisagar, Panch Mahal and Chhota Udaipur in Gujarat and shares border with the states of Madhya Pradesh and Rajasthan. The city of Dahod is the administrative headquarters of Dahod district. The district population as per Census 2011 is 2.13 million with a decadal growth rate of about 30 percent. The work participation rate (WPR) is about 47 percent.

Dahod is predominantly an agricultural region, and the prime share of revenue comes from the agriculture and related products. Wheat and maize are the major crops produced. Home-based industries such as jute rope and bamboo weaving has grown due to the agriculture driven economy. The economy also thrives on the grain & pulse mills, food processing machinery, and cement & gypsum industries. Small scale industrial clusters are mostly located in Dahod and Devgadh Baria talukas. There are some stone crushers present along the corridor near Dahod; however, it does not have a significant impact on the project corridor as the crushers are fed with locally mined raw materials and the crushed stones are supplied locally.

Quartz is the major mineral which is produced along with other minor minerals such as black trap, quartzite, murram, ordinary sand and clay, etc. 4,000 MT of quartz is produced in the district and supports cement, glass and ceramic industries. Gujarat Fluoro Chemicals Limited in Goghamba taluka is a public sector unit involved in manufacturing of refrigerants. Dahod has been selected as one of the hundred Indian cities to be developed as a smart city under Smart Cities Mission. The Smart City development would help in providing better quality of life for the citizens of Dahod.

Panch Mahal District

Panch Mahal district is located on the eastern part of Gujarat with an area of 5,231 sq. km. It is spread over 7 talukas with Godhra as the district headquarter. The district is known for the world heritage site Champaner.

According to 2011 census, the district has a population of 2.39 million with decadal growth of about 18 percent. Agriculture and livestock are the mainstay of livelihood with about 76 percent of the population involved in agriculture. Agricultural produce include mango, banana, papaya, citrus, guava, brinjal, cabbage, cauliflower, cucurbits, onion, garlic, ginger etc. Wheat, maize and pulses are major crops produced in the district.

Major minerals produced include quartz, manganese ore and limestone with other minor minerals such as black trap, quartzite, murram, etc. It is the largest producer of quartz

(about 97 percent). The district is a manufacturing base for steel products, automobiles and cryogenic equipment. Glassware, ceramics and cement industries are gradually emerging due to the presence of quartz in the district. Small scale industry sectors such as food processing units, wooden products and machine tools are the supporting pillars of the economy with major industrial clusters being located at Kalol, Halol and Godhra.

2.3 Traffic Surveys

In order to understand the characteristics of traffic using the project road, data on road network, traffic and travel pattern of vehicles plying on the project road were collected through primary traffic surveys. Origin-destination (OD) survey as roadside interview method for one day at toll plaza location was conducted on the project road. The schedule of the traffic surveys carried out as part of this study and location on the project road are given in **Table 2-1**.

Location	Chainage	Duration	Date(s)
Origin and Destination Survey			
Bhatwada TP	Km 146.500	1 Day	1st March 2023

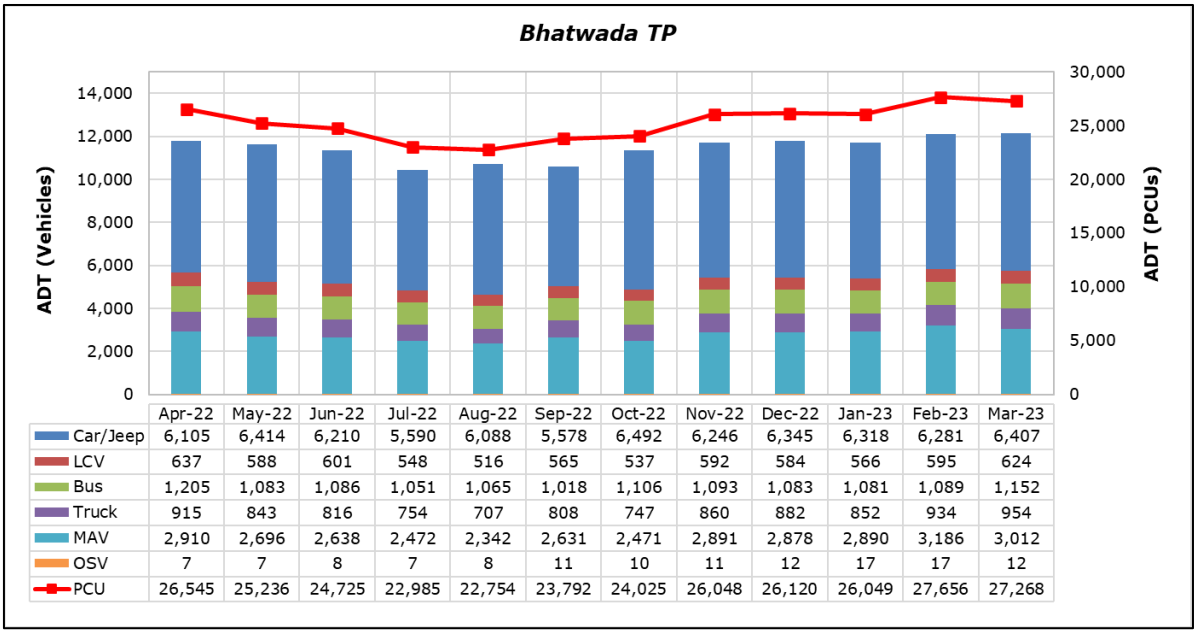
Table 2-1: Traffic Survey Location and Schedule

Trained enumerators were engaged for conducting traffic surveys under the supervision of experienced transport planners.

2.4 Traffic Characteristics – AADT FY23

The traffic data at the toll plaza location was provided by the client for the period from November 2013 to March 2023.

For FY23, 12 months data from April 2022 to March 2023 is available and is presented in **Figure 2-3**.



	Apr-22	May-22	Jun-22	Jul-22	Aug-22	Sep-22	Oct-22	Nov-22	Dec-22	Jan-23	Feb-23	Mar-23
Car/Jeep	6,105	6,414	6,210	5,590	6,088	5,578	6,492	6,246	6,345	6,318	6,281	6,407
LCV	637	588	601	548	516	565	537	592	584	566	595	624
Bus	1,205	1,083	1,086	1,051	1,065	1,018	1,106	1,093	1,083	1,081	1,089	1,152
Truck	915	843	816	754	707	808	747	860	882	852	934	954
MAV	2,910	2,696	2,638	2,472	2,342	2,631	2,471	2,891	2,878	2,890	3,186	3,012
OSV	7	7	8	7	8	11	10	11	12	17	17	12
PCU	26,545	25,236	24,725	22,985	22,754	23,792	24,025	26,048	26,120	26,049	27,656	27,268

Figure 2-3: MoM Traffic of FY23 on the Project Road

For the estimation of base traffic for FY23, the 12-month average traffic of April 2022 to March 2023 has been considered as the AADT for FY23 which is presented in **Table 2-2**.

Mode	Car	LCV	Bus	2A	MAV	PCU
AADT FY23	6,173	579	1,093	839	2,762	25,267

Table 2-2: AADT FY23 at Bhatwada TP as per Tolling Categories

2.5 Travel Characteristics

2.5.1 Survey Methodology

In order to understand the travel demand pattern in the region and tollable traffic streams, origin and destination (OD) surveys were carried out at the toll plaza location. The OD survey was carried out for 24 hours, by roadside interview method as described in IRC: 102-1988. Both passenger and commercial vehicles plying on the project road were stopped on a random sampling basis and interviewed.

The travel characteristics obtained by OD survey facilitate the identification of:

1. Local and through traffic on the project road.
2. Potential divertible traffic to/from project road to various alternative routes.

Trained enumerators under the supervision of transport planners collected the trip characteristics using survey forms designed for this purpose. The OD survey elicited characteristics like origin, destination, frequency, purpose of trip for passenger vehicles and commodity being transported for goods vehicles. The information pertaining to origin and destination of trips collected during roadside interviews was analysed to obtain the trip distribution based on a zoning system suitably designed for the present study.

2.5.2 Traffic Zoning System

To understand the spatial dimensions of the trip characteristics of the vehicles interviewed during the O-D survey, a detailed zoning system was developed giving due consideration to the following factors:

- The road network catering to the traffic on the project road and its generating points
- Important towns, villages, factories and industrial centres around the project road area
- Administrative boundaries of districts and states.
- Configuration of the project road in the regional road network with respect to other roads

Two major types of areas were identified for analysis purpose: -

Immediate Influence Area (IIA): It includes the cities/towns/villages and districts along the project road and adjacent to it, which generate/attract trips to the project road. In

this study, it consists of districts of Dahod and Panch Mahal Districts in the state of Gujarat.

Broad Influence Area (BIA): It includes the remaining districts of Gujarat and other neighbouring states such as Madhya Pradesh, Rajasthan, Maharashtra and remaining states of India.

Detailed zoning system is prepared for IIA, while more aggregate or broad zoning is developed for BIA. The zoning system adopted for data collection was based on 77 zones and is presented in **Appendix 2.1**.

2.5.3 Sample Size

The vehicles during the OD surveys were interviewed on a random sample basis. **Table 2-3** shows the AADT and the sample size (both in absolute numbers and in percentage terms) captured during the exercise.

Modes	Car	Bus	LCV	2A	MAV
Bhatwada TP					
Sample	2,734	480	481	278	1,366
AADT	6,173	1,093	579	839	2,762
Percentage (%)	44.3	43.9	83.0	33.1	49.5

Table 2-3: Sample Size Collected in OD

Based on the sample size of different categories of vehicles interviewed during the OD survey, direction-wise expansion factors were calculated based on FY23 AADT. The OD matrices for all vehicle categories were generated and analysis was done in terms of regional distribution, travel pattern and commodity distribution.

2.5.4 Regional Distribution

Based on the OD matrices, the regional distribution of tollable vehicles at the toll plaza location has been calculated. **Table 2-4** gives the distribution indicating the attraction and generation zones for the traffic on the project road.

Region/Modes	Car	Bus	LCV	2A	MAV
Bhatwada TP					
Gujarat	90.3	96.5	79.2	78.3	66.0
Madhya Pradesh	8.0	2.0	16.8	15.4	23.2
Rajasthan	0.6	0.4	0.9	1.7	2.5
Maharashtra	0.4	0.2	1.1	2.7	2.0
Uttar Pradesh	0.2	0.3	1.3	1.8	3.9
Delhi	0.1	0.1	0.1	0.0	0.2
Punjab	0.0	0.0	0.2	0.0	0.0
Haryana	0.0	0.0	0.2	0.0	0.1
Rest of India	0.4	0.3	0.1	0.0	2.1
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Table 2-4: Regional Distribution of Tollable Traffic (in %) at Bhatwada TP

Passenger Traffic:

- Majority of the passenger traffic at the toll plaza location is from the state of Gujarat. Car traffic at the toll plaza location accounts for about 90.3 percent followed by Madhya Pradesh accounting for 8 percent.
- In case of bus traffic, Gujarat state accounts for around 96.5 percent followed by Madhya Pradesh accounting for 2.0 percent.

Freight Traffic:

- Around 79.2 percent of the LCV traffic is from the state of Gujarat, followed by Madhya Pradesh and Rajasthan accounting for 16.8 percent and 0.9 percent respectively.
- In 2A trucks, around 78.3 percent is from Gujarat followed by Madhya Pradesh accounting for 15.4 percent.
- In case of MAV, Gujarat accounts for a share of about 66 percent followed by Madhya Pradesh and Uttar Pradesh accounting for about 23.2 percent and 3.9 percent respectively.

The mode wise top 20 OD pairs are given in **Appendix 2.2**.

2.5.5 Travel Pattern

In order to assess the travel pattern of vehicles, the important streams of traffic plying on the project road are estimated. The list of the popular movements found at Bhatwada TP is presented in **Table 2-5**.

S. No	Traffic Streams	Car	Bus	LCV	2A	MAV
1	Godhra & Surroundings to Dahod & Surroundings	49.2%	35.3%	30.1%	17.5%	6.6%
2	Godhra & Surroundings to Indore & Surroundings	1.6%	0.5%	4.6%	2.8%	4.5%
3	Godhra & Surroundings to Beyond Indore	0.8%	0.5%	3.9%	0.3%	4.2%
4	Ahmedabad/Vadodara & Surroundings to Dahod & Surroundings	30.2%	56.4%	28.8%	43.2%	28.3%
5	Ahmedabad/Vadodara & Surroundings to Indore & Surroundings	10.6%	3.3%	17.7%	18.4%	25.0%
6	Ahmedabad/Vadodara & Surroundings to Beyond Indore	4.6%	1.8%	11.3%	9.2%	25.0%
7	Beyond Ahmedabad/Vadodara & Surroundings to Dahod & Surroundings	1.9%	2.0%	1.3%	2.2%	1.8%
8	Beyond Ahmedabad/Vadodara & Surroundings to Indore & Surroundings	0.8%	0.0%	1.7%	3.6%	2.3%
9	Beyond Ahmedabad/Vadodara & Surroundings to Beyond Indore	0.4%	0.2%	0.7%	2.7%	2.5%
Total		100.0%	100.0%	100.0%	100.0%	100.0%

Table 2-5: Traffic Streams at Bhatwada TP

Passenger traffic:

- Around 49.2 percent of car trips and 35.3 percent of bus trips originate and terminate within Godhra & surroundings to Dahod & surroundings (stream 1). Dahod and Godhra being tier II cities contribute to majority of car traffic. It may be noted that majority of car trips were found to be for the purpose of work and business at the toll plaza location.
- About 30.2 percent of car and 56.4 percent of bus are found to be plying between Ahmedabad/Vadodara & surroundings and Dahod & surroundings (stream 4).

Freight traffic:

- In case of LCV, about 30.1 percent were found to be travelling from/to Godhra & surroundings to/from Dahod & surroundings (stream 1)
- The interaction between Ahmedabad/Vadodara & surroundings to Indore & beyond (stream 5 + stream 6) is about 27.6 percent of 2A and 50 percent of MAV.
- About 28.8 percent of LCV, 43.2 percent of 3A and 28.3 percent of MAV traffic were found to travel from/to Ahmedabad/Vadodara & surroundings to/from Dahod & surroundings (stream 4).

2.5.6 Commodity Distribution

Analysis was also carried out to understand the different commercial vehicles being used to transport different commodities. The commodity distribution for project corridor is presented in **Figure 2-4**.

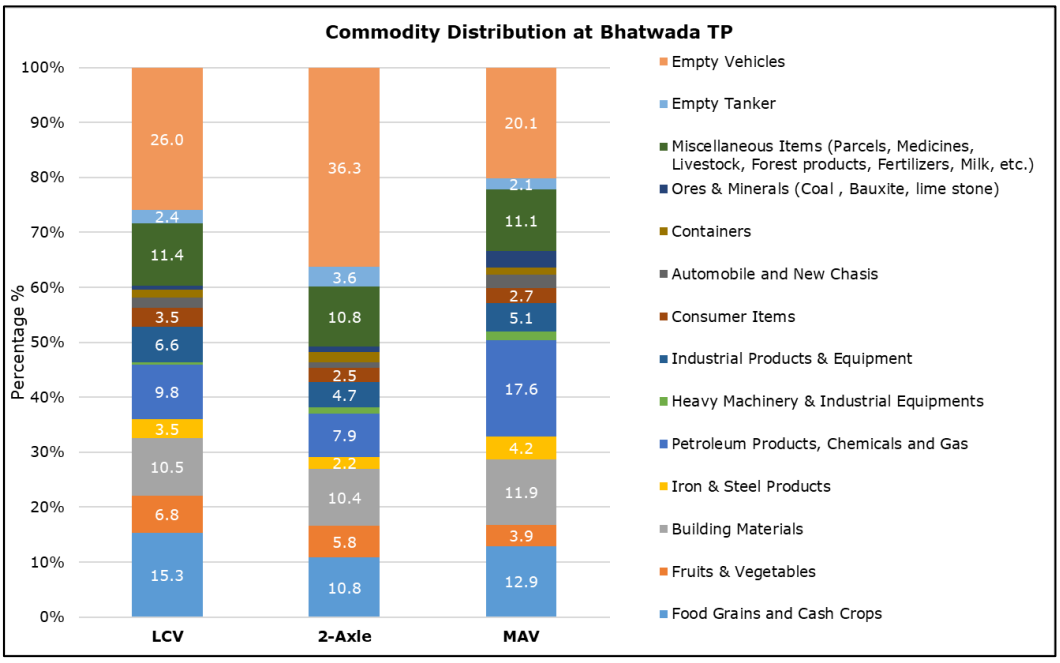


Figure 2-4: Commodity Distribution on Project Corridor

- Major commodities being transported across the project road are food grains and cash crops, petroleum/gas products, building materials, miscellaneous items etc.
- About 15.3 percent of LCV, 10.8 percent of 2A and 12.9 percent of MAV are found to be transporting food grains and cash crops at the toll plaza location.
- About 10-12 percent of 2A/MAV were found to be laden with building materials.
- Around 10-11 percent of 2A/MAV are found to be transporting miscellaneous items (Parcels, Medicines, Livestock, Forest products, Fertilizers, Milk, etc).

Table 2-6 presents the direction wise commodity-wise share on the project road.

Godhra-Indore				Indore-Godhra		
LCV	2A	MAV	Commodity	LCV	2A	MAV
11.2	7.2	8.0	Food Grains and Cash Crops	18.9	13.2	16.8
9.3	10.8	4.9	Fruits & Vegetables	4.5	2.4	3.1
15.3	18.0	16.5	Building Materials	6.2	5.4	8.1
2.8	1.8	1.8	Iron & Steel Products	4.1	2.4	6.1
14.9	9.0	19.9	Petroleum Products, Chemicals and Gas	5.3	7.2	15.6
0.0	2.7	2.3	Heavy Machinery & Industrial Equipment's	0.8	0.0	1.1
9.8	8.1	7.8	Industrial Products & Equipment	3.7	2.4	2.9
5.1	4.5	3.9	Consumer Items	2.1	1.2	1.7
2.3	1.8	5.1	Automobile and New Chassis	1.2	0.6	0.3
1.9	3.6	1.8	Containers	1.2	0.6	1.1
0.5	1.8	4.1	Ores & Minerals (Coal, Bauxite, limestone)	0.8	0.6	2.1
15.8	10.8	11.3	Miscellaneous Items (Parcels, Medicines, Livestock, Forest products, Fertilizers, Milk, etc.)	7.4	10.8	11.0
5.1	9.0	4.6	Empty Tanker	0.0	0.0	0.1
6.0	10.8	8.0	Empty Vehicles	43.6	53.3	30.0
100.0	100.0	100.0	Total	100.0	100.0	100.0

Table 2-6: Direction wise Commodity Distribution on Project Road

- Petroleum products, chemicals and gas tankers were the most noticeable commodity observed in the direction of Godhra-Indore which accounts for around 20 percent in case of MAV. With no major production centres along the route, this traffic is mainly of distributive nature for general distribution of petroleum at or near Dahod and areas on the eastern side.
- Significant volume of food grains and cash crops were being transported by all the modes of freight vehicles (around 18.9 percent of LCV, 13.2 percent in 2A and 16.8 percent of MAV in the direction of Indore-Godhra) due to the presence of "Dahod Anaj Mandi" which is the second largest food grain market in Gujarat.
- In case of empty vehicles, top OD pairs of freight vehicles are to/from Ahmedabad /Vadodara/Godhra from/to Dahod/Indore. The vehicles after unloading of commodities such as foodgrains, petroleum etc return empty in the direction of Indore-Godhra to their respective demand centres.

3. TRAFFIC GROWTH RATE AND PROJECTIONS

3.1 General

As the project road has been executed on a DBFOT basis with a concession period of 27 years, an estimation of the traffic using the tolled highway and its future growth are important elements to assess the project's economics as they are generally the main/sole source of revenue for the project. This chapter details various aspects of the current traffic of the project road and its growth potential.

3.2 Project Road Traffic

The traffic that is likely to use the project road was estimated on the basis of the traffic and travel characteristics gathered as part of the study. The traffic on the project road would normally consist of the following components:

- Normal Traffic
- Diverted Traffic
- Induced/Developmental Traffic

3.2.1 Normal Traffic

Normal traffic is the traffic which is already plying on the project road as assessed in section 2.4.

3.2.2 Diverted Traffic

Diverted traffic is generally dictated by the presence of an alternative route at a lower generalised cost, which is in-turn defined by the road configuration and its condition, the type of vehicle and its operating costs, the average riding speed, the route distance and any tolling that may apply on a specific route. A detailed road network assessment along with site reconnaissance survey was conducted on the project road and vicinity to identify alternate routes. In case of the project road, the tolling has been at place since 2013, the travel pattern is well established. No alternate route has been found from/to where the traffic may divert.

However, two major developments that could impact the project road traffic are:

- Under construction Delhi-Mumbai Expressway (DME)
- Indore-Dahod new rail link

The assessment of any likely traffic addition to/diversion away from the Project Road (PR) has been done using the cost ratio analysis as described below:

- Assessment of the potential divertible traffic sensitive to network improvements based on the observed travel pattern
- Calculation of road user cost of travelling on the project road and the alternative route. The road user cost includes vehicle operating cost (VOC), travel time cost

(TTC) and toll cost (TC), if any. VOC comprises of the cost of fuel, spare parts, maintenance labour, tyre, engine oil, grease, fixed cost, depreciation and crew wages.

- The toll rates for DME are considered as 1.5 times the normal NHAI per km toll rates (accounting for 1.25 times for normal length of expressway and increase for the likely equivalent structure length).
- Analysis has been done only for larger axle trucks as these vehicles travel long lead and are potential to shift to DME

The road user cost is estimated based on vehicle operating cost equations presented in IRC SP-30,2019 which is based on updation of Road User Cost Study (RUCS) carried out by Central Road Research Institute in 2019 for Ministry of Road Transport and Highways. Using the likely traffic stream speeds and lane configuration, the vehicle operating, and travel time costs are estimated for each of the routes. Road user cost on the identified routes is calculated and diversion percentages are estimated using diversion curve method mainly for trucks. In this method, traffic likely to be diverted from/to the project road, was estimated using Logit model, which computes expected diversion percentage based on the ratio of perceived cost on the existing and proposed facilities. The perceived cost is the financial vehicle operating cost and the time saving cost including toll charges (if any). According to the model, a vehicle will shift if the perceived cost on an alternative route is lower in comparison to existing route. The diversion equations for estimating diversion have been adopted from Indian National Expressway Network Report, MORTH (2009) as mentioned in IRC 108:2015. These equations are presented in **Table 3-1**.

Vehicle	Cost Ratio (CR) Interval	Equations
Truck	<= 0.750	% Div. = 100 - ((CR/0.75) * 5)
	0.750 <= CR <= 1.250	% Div. = 95 - ((CR-0.75)/0.5) * 90
	1.250 <= CR <= 2.0	% Div. = ((2-CR)/0.75) * 5

Source: IRC 108-2015

Table 3-1: Diversion Equations Used for Analysis

Delhi – Mumbai Expressway

Delhi–Mumbai Expressway is an under-construction 1,296 km long controlled-access highway connecting the national capital Delhi with India's commercial capital Mumbai. The expressway is on a greenfield-alignment and will be 8-lane facility (4 lanes in each direction). Being a signal-free access-controlled corridor between the two cities running across five states will cut down the travel time from 25 hours to 12 hours.

This Expressway was first announced in April 2018 by Union Minister Nitin Gadkari and as per the latest update, the section from Sohna-Dausa-Lalsot recently opened for public use and the remaining sections is targeted to be completed by end of 2024. The alignment of Delhi – Mumbai Expressway passes through the states of Haryana (80km),

Rajasthan (375km), Madhya Pradesh (245km), Gujarat (425 km) and Maharashtra (170km). The alignment of Delhi-Mumbai Expressway and in context of the project section is presented in **Figure 3-1**.

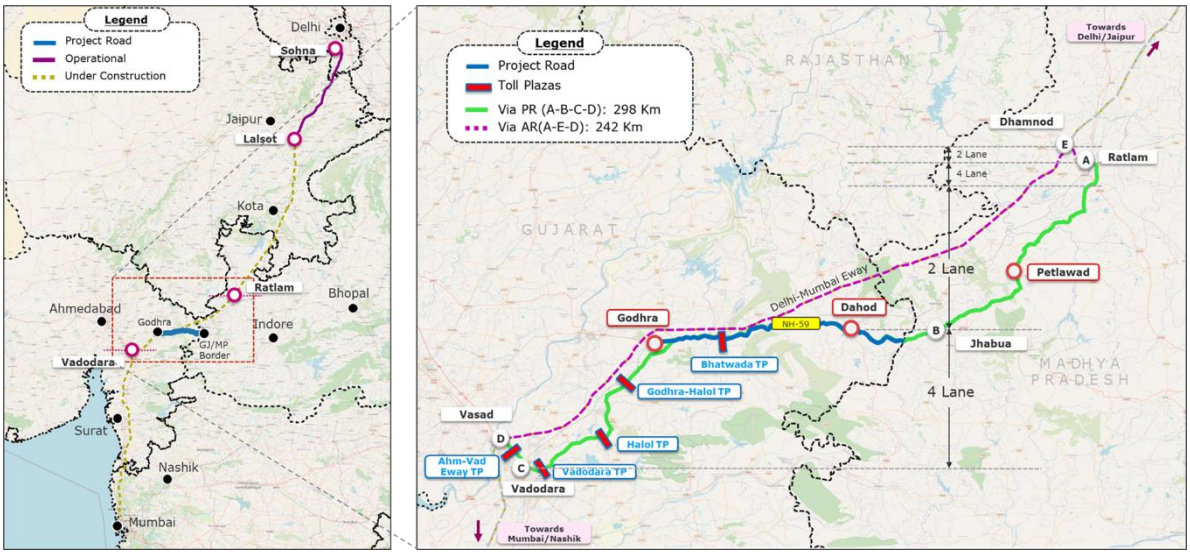


Figure 3-1: Alignment of Under Construction Delhi – Mumbai Expressway

This expressway once completed may attract some of the freight vehicles which are currently using the project road travelling between Ratlam & beyond to Vadodara & beyond.

The route via project section from Ratlam to Vadodara is about 298 km as against 242 km via DME. Thus, the route via DME is about 56 km shorter than the route via PR.

The share of project road after the opening of Delhi-Mumbai Expressway has been estimated using cost ratio analysis. The assessment has been done for the traffic plying between Ratlam & beyond and Vadodara & beyond.

Assessment of potential divertible traffic has been done from the OD analysis of the toll plaza. The potential divertible traffic for these streams of traffic is presented in **Table 3-2**.

Modes	Car	LCV	Truck	3A/MAV
A) Potential Traffic	176	18	12	108
B) Potential as % of AADT	2.9	3.1	1.5	3.9
C) AR Share in %	73.2	80.2	95.3	95.4
Loss as % of AADT				
D) Total Diverted as % of AADT (B*C)	2.1	2.5	1.4	3.7
Adopted Loss as % of AADT				
E) Captive Traffic for PR (%)	33.3	33.3	33.3	33.3
F) Diverted to Expressway (%) = D*(1-E)	1.0	1.0	1.0	2.0

Table 3-2: Diverted Traffic due to DME

The cost-ratio based analysis indicates loss of 2.1 percent for Car, 2.5 percent for LCV, 1.4 percent for 2A and 3.7 percent in 3A/MAV. However, the alternate route consisting of the greenfield expressway of DME may not be able to attract whole of this traffic. The

freight vehicles using the route via project road may still prefer the national highway network due to cargo distribution points along the route, familiarity of the route and wayside amenities along the route via project road. In light of this, about 2/3rd of the total diverted traffic is envisaged to shift to the alternate route. Thus, the project road may have a loss of about 1.0 percent each of Car, LCV & 2A and around 2.0 percent in 3A/MAV once the alternate route is fully operational.

Also, as DME alignment is closer to the project road, with a likely interchange near Godhra, there could also be an upside to the project road traffic. Some of the traffic from/to Mumbai to/from Indore and other eastern parts of MP may use the greenfield expressway till Godhra and then use the project road to go towards Indore and rest of MP. However, it is difficult to quantify the impact at this stage of analysis. Therefore, no impact on the project road traffic has been considered in further analysis.

Indore –Dahod New Rail line

At present, there is a railway line under Western Railway connecting Ahmedabad and Ratlam via Dahod running parallel to the project road. The Ahmedabad-Indore connectivity is via the broad guage Ratlam/Barnagar line, making it longer by rail as compared by road. A direct single line rail link from Dahod and Indore is being constructed which is likely to reduce the travel distance.

The 201 km railway link from Dahod to Indore being constructed is of utmost importance to the region as it will connect south-western part of Madhya Pradesh. Out of this 201 km, only 20 km is in Gujarat and remaining 180 km falls in Madhya Pradesh. The alignment of the railway line is given in **Figure 3-2**.

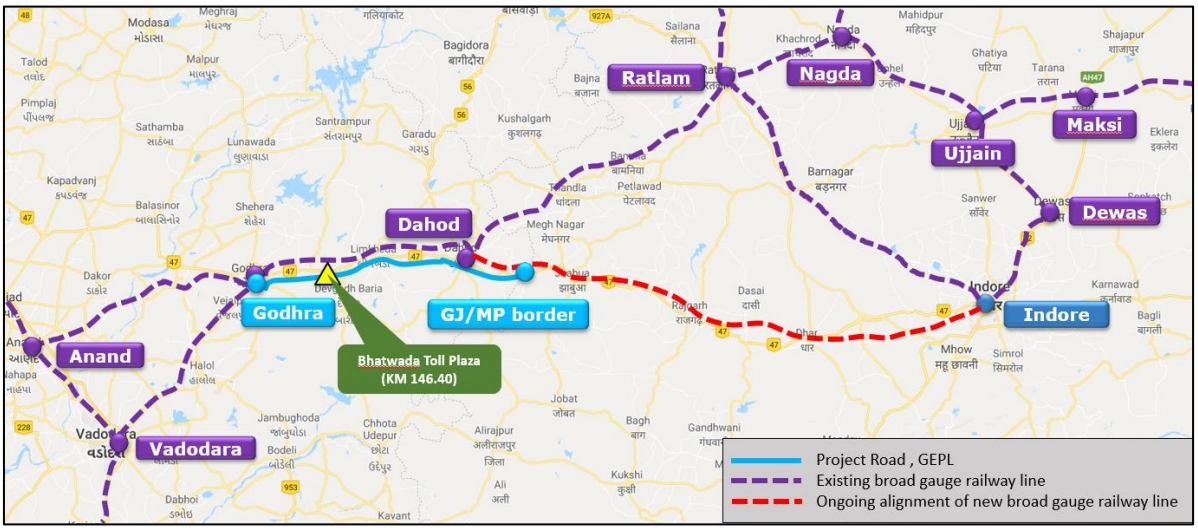


Figure 3-2: Alignment of Dahod-Indore Railway Line

The project was sanctioned in 2008 and was supposed to complete by 2011, but due to land acquisition issues and realignment for the construction of tunnel between Dhar and Pithampur the project is further delayed. However, information collected at site and

through public domain indicates that work for the project is on and is likely to complete by 2028.

The commodities which are being transported via rail are already using existing route via Ratlam where Indian Railways has a railway siding for containers which comprises of fertilisers, food grains, cement for inward movement and for Soya DE-oil cake, food grains for outward movement. It is worth mentioning that the Indian Railways transports the commodities only for which it has a storage facility at that station.

A broad assessment carried out to estimate the potential traffic carrying the bulk commodities amenable to shift to railways (petroleum and minerals) indicates that only 1.7 percent of MAVs might shift to the under-construction rail link.

However, with the presence of the already existing rail links around the corridor, the mode choice of freight traffic on the corridor is well established. The proposed rail link from Dahod to Indore though will lead to reduction in travel distance for the railway movement but being a single line, will have high turn-around time which may not be cost effective alternative for a further shift from road to rail. In view of this, there is less probability of further inter modal shifts on the corridor.

3.2.3 Induced/ Development Traffic

Developmental /new generated traffic is the one which would be generated, over and above normal growth, because of lowering of transport costs or new developments in the immediate influence area of the project road.

Bharatmala Pariyojana is the second largest highways construction project in the country since NHDP, under which almost 50,000 km or highway roads were targeted across the country. It will look to improve connectivity particularly on economic corridors, border areas and far-flung areas with an aim of quicker movement of cargo and boosting exports.

It will connect 550 district headquarters to minimum 4-lane highway by raising the number of corridors to 50 (from current 6) and move 80 percent freight traffic (currently 40 percent) to national highways by connecting 24 logistics parks and 7 north east multimodal waterway ports.

The Phase-I includes economic corridors of around 9,000 km; inter-corridor and feeder routes of around 6,000 km; 5,000 km roads under the National Corridors Efficiency Program, border and international connectivity roads of around 2,000 km; coastal and port connectivity roads of around 2,000 km; expressways of around 800 km and 10,000 km of NHDP roads. The total length in phase 1 comes to around 34,800 km.

In the context of the project influence area, there are two economic corridors, one inter-corridor and one feeder road which are identified under this project as presented in **Figure 3-3**.

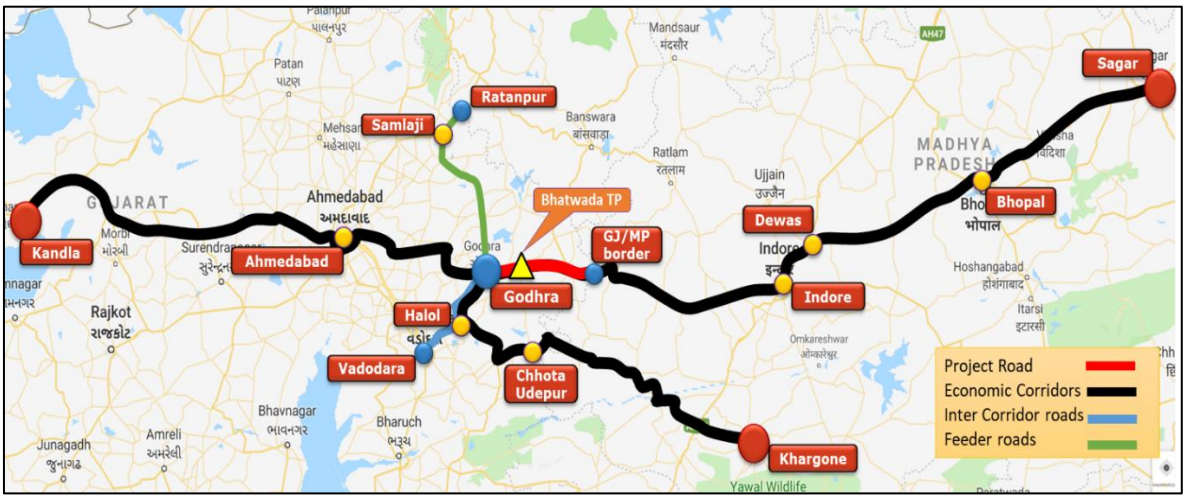


Figure 3-3: Details of Upcoming Projects under Bharatmala in PIA

The project road is a main connecting link of the Kandla-Sagar economic corridor, it is likely to remain an important highway for the East/West movement and may see sustained growth in the future. This has been considered while setting out traffic growth rates for rest of the concession period. Another economic corridor in the vicinity is Godhra to Khargone. In addition to this, Godhra to Vadodara has been identified as the inter corridor road and Godhra to Shamlaji is the feeder road.

3.3 Methodology for Traffic Growth Rate Estimation

3.3.1 Methodology

Traffic growth for both passenger and freight vehicles has been estimated using the econometric approach as described in IRC-108, 2015. For freight traffic, due consideration has been given to the total tonnage transported and the shift in types of vehicles used for moving goods.

The econometric model applied, relates traffic growth to changes in state (or district) domestic product via an elasticity factor. According to IRC guidelines, elasticity based econometric model for highway projects should be derived in the following form:

Log e (P) = A0 + A1 Log e (EI)

Where:

P	= Traffic Volume
EI	= Economic Indicator
A0	= Regression constant
A1	= Regression co-efficient (Elasticity Index).

In order to estimate traffic on the project road the methodology described below has been followed:

- Identify the influence area - From the analysis of travel patterns observed from the OD survey data, the influencing states and districts, which are likely to impact the traffic growth on the project road, were identified.

- Review Past Traffic Data – Based on data points available for the project corridor from different sources a review of past traffic and tonnage growth is carried out.
- Analysis of economic growth of the Project Influencing Area (PIA) - For each PIA state an economic profile describing past performance and future outlook was prepared. This also considers India's past economic performance and its future outlook.
- Estimation of traffic elasticity to income – in order to translate economic growth into traffic growth, an elasticity factor was estimated.
- Derivation of traffic growth rates – On the basis of the traffic weighted PIA outlook and related traffic elasticity, traffic growth rates were estimated.

The methodology thus adopted incorporates, as basic data inputs, the perspective growth envisaged in the influence area and the changes in transport demand elasticities over a period of time. The traffic growth rates by vehicle type for the project road have been determined till FY44 in line with the maximum possible extension of the concession period.

3.4 Identification of PIA States

The travel pattern as derived from origin and destination survey analysis reveals the predominance of Gujarat in passenger and freight vehicles. Besides Gujarat, the state of Madhya Pradesh also contributes a considerable share to the project road passenger and freight traffic.

The normalised shares of the two influencing states derived from the OD survey data analysis of the toll plaza location are presented in **Figure 3-4**.

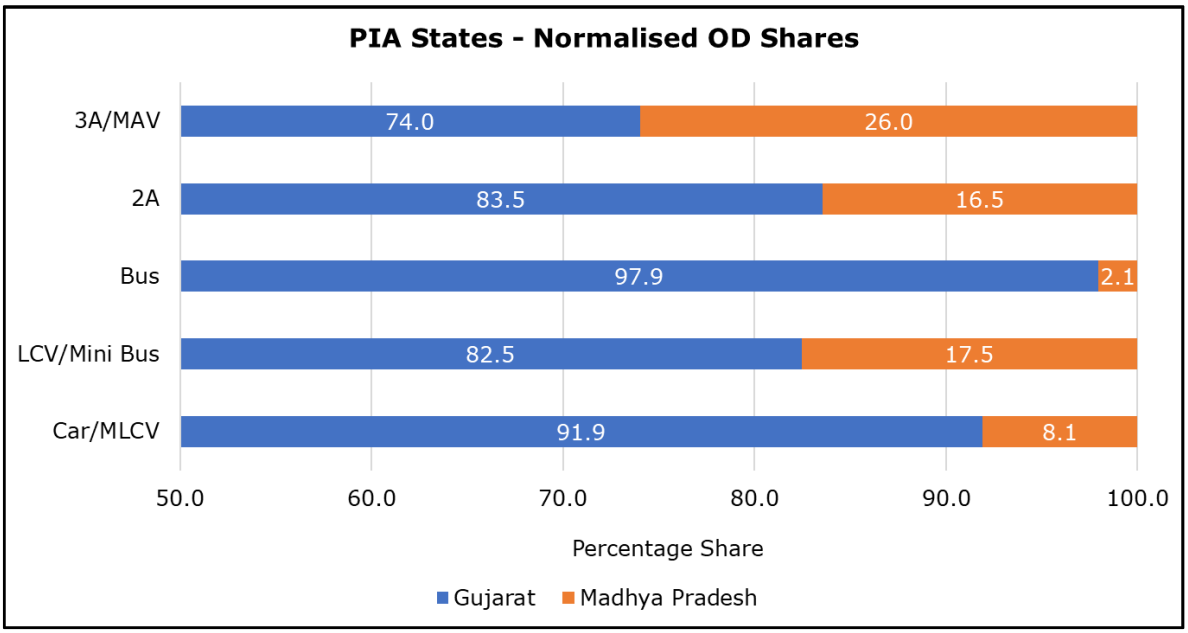


Figure 3-4: Normalised OD Shares for the Project Road

The travel pattern observed at the toll plaza location reveals that 91.9 percent of the Car/MLCV traffic and 97.9 percent of the Bus traffic are from the state of Gujarat indicating the dominance of Gujarat in passenger vehicle category. Madhya Pradesh also has a considerable share of 8 percent in cars and 2 percent in buses.

The share of freight traffic from Gujarat for LCV/M Bus, 2A trucks and MAVs are 82.5 percent, 83.5 percent, and 74 percent, respectively, indicating heavy influence of Gujarat in the freight vehicles category. Additionally, Madhya Pradesh contributes around 17.5 percent in LCV/M Bus, 16.5 percent in 2A trucks and 26 percent in MAV category.

Looking at the predominance of Gujarat and Madhya Pradesh in both passenger and freight traffic, these two have been considered as the PIA states for both passenger and freight vehicles.

3.5 Past Economic Growth of PIA

Growth of traffic on the project road depends on existing development and future growth prospects of the connecting regions. A number of economic indicators for the PIA state, as published by Central Statistical Organisation (2011/12 prices), have been studied to assess their past performance.

Primary PIA State- Gujarat

The state of Gujarat has been considered as the Primary PIA state, as it contributes the majority share of traffic on the project road. Past economic performance of the state has been as follows:

- Gujarat's Gross State Domestic Product (GSDP) stood at Rs 12,652.8 billion in 2019-20 and has been growing at a compounded annual growth rate of 9.6 percent since 2011-12. FY21 has been impacted by Covid 19 and shows a negative growth.
- The secondary sector is the largest contributor to GSDP (46.3 percent), agriculture allied activities sector at 17.2 percent and services sector at 36.4 percent of the GSDP in 2019-20.

The change of sectoral composition of GSDP over the years is presented in **Figure 3-5**.

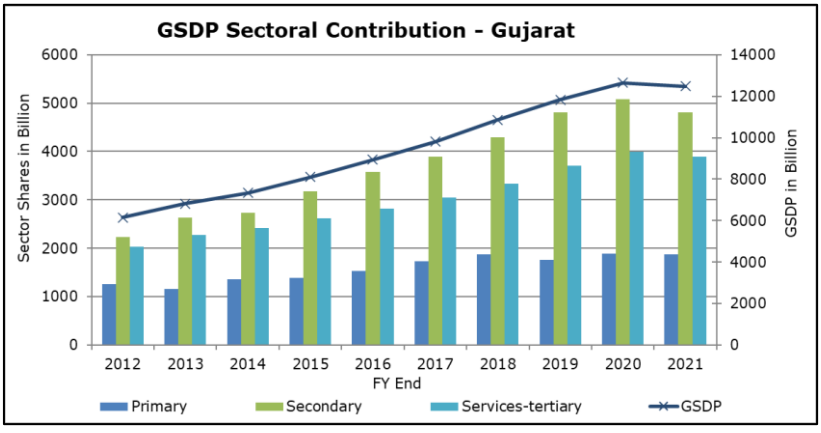


Figure 3-5: GSDP (in Rs billion) and its Sectoral Composition for Gujarat

The performance of the state economy and its different sectors has been studied using time trend analysis. The average annual growth rates as obtained using regression analysis are presented in **Table 3-3**.

Particulars	2011-12 to 2019-20	2014-15 to 2019-20
GSDP	9.6	9.5
Agriculture and Allied	6.5	6.1
Industry	10.9	10.0
Services	8.6	9.0
Construction	3.7	4.1
Per Capita Income	8.2	8.0

Table 3-3 : Average Annual Growth Rates (%) of State Income for Gujarat

Gujarat is a predominant exporter of organic chemicals and petroleum products. Currently, the state has 21 operational Special Economic Zones (SEZs). Also, 26 more have been formally approved and 22 have been notified. These SEZs are dispersed over a manifold range of sectors including textiles & articles of textile, engineering products, non-conventional energy equipment, multi-product, pharma, IT SEZs, etc.

The well-known SEZs of Gujarat are M/s. Adani Port & Special Economic Zone Limited., M/s. Reliance Industries Ltd. and Sterling SEZ & Infrastructure Ltd.

The dedicated freight corridor, the Delhi-Mumbai Industrial Corridor (DMIC), passes through the state. This corridor is expected to facilitate connectivity to non-major ports with an aim to provide conducive business environment. In addition, conversion of Gandhinagar-Chiloda stretch of S.G.Highway starting from Sarkhej, passing through the Ahmedabad City, into six lane is ongoing at a cost of Rs. 867 crores. Projects for developing flyover at Sindhu Bhavan junction, an over bridge on Sarkhej-Sanand road and Uvarsad flyover at the gateway of Gandhinagar are also in progress.

The state is also developing High Speed Rail Passenger Corridor from Mumbai to Ahmedabad with the Japan government's corporation. This route will reduce the travel time between the two cities. The anticipated cost of the project is approximately US$ 14.92 billion. In March 2021, Gujarat allocated Rs. 15 billion for development of the Ahmedabad–Mumbai bullet train. The bullet train corridor will cover a length of 508.17 kms and comprises 12 stations in Gujarat, Maharashtra and the UT of Dadra and Nagar Haveli. In July 2022, the government approved the construction of Taranga Hill-Ambaji-Abu Road new rail line to provide connectivity and improve mobility.

In July 2021, ESR India announced its expansion plan in Gujarat and intends to invest Rs. 300 crore (US$ 40.45 million) to develop an industrial and logistics park in the state.

In July 2022, Deendayal Port Authority (DPA) announced plans to develop two Mega Cargo Handling Terminals on a Build-Operate-Transfer (BOT) basis under Public-Private Partnership (PPP) mode at an estimated cost of Rs. 5,963 crores. In state budget 2021-22, the government plans to develop Nargole and Bhavnagar ports according to the PPP model with an investment of Rs.4,800 crore.

According to by Department for Promotion of Industry and Internal Trade (DPIIT), the state has enticed the Foreign Direct Investment (FDI) equity inflows worth US$ 48.5 billion during the period 2001 to 2021 and Gujarat received the highest FDI (Foreign Direct Investment) of US$ 21.89 billion in FY21.

The per capita income of Gujarat is Rs 1,82,042 in the year 2020-21. During FY11 to FY21, a growth of about 7.5 percent is seen in the state's per capita income. The growth in per capita income of Gujarat since 2011-12 is presented in **Figure 3-6**.

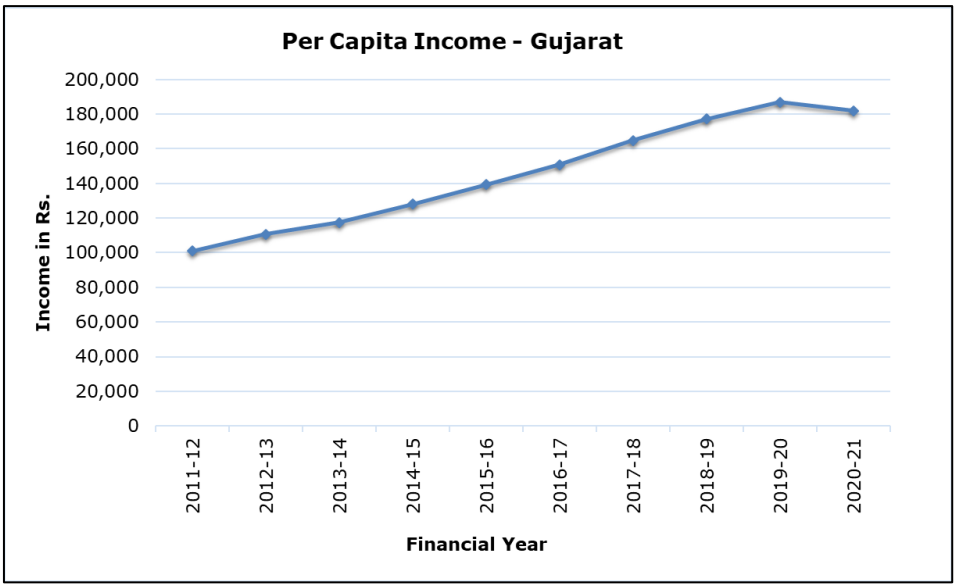


Figure 3-6: Per Capita Income of Gujarat 2011-12 to 2020-21

Other PIA State

The other PIA state contributing to the traffic on the project road is Madhya Pradesh. The economic indicators of Madhya Pradesh are as follows.

- Gross State Domestic Product (GSDP) of Madhya Pradesh stood at Rs 5,755.5 billion in 2019-20 and has been growing at a compounded annual growth rate of 7.8 percent since 2011-12. The state has shown a 10.1 percent growth in FY22 which is partially due to the low base in FY21.
- The services sector is the largest contributor to GSDP (39.0 percent), agriculture allied activities sector at 35.2 percent and secondary sector at 25.9 percent of the GSDP of the state of Madhya Pradesh in 2019-20.

The average annual growth rates as obtained using regression analysis till the last available year are presented in **Table 3-4**.

State/Particular	Madhya Pradesh
	2011-12 to 2019-20
GSDP	7.8
Primary	6.9
Secondary	7.8
Tertiary	7.1

State/Particular	Madhya Pradesh
	2011-12 to 2019-20
Construction	3.9
Per Capita Income	6.2

Table 3-4: Average Annual Growth Rates (%) of State Income for other PIA State

The GSDP over the years for the states of Gujarat and Madhya Pradesh are presented in **Figure 3-7**.

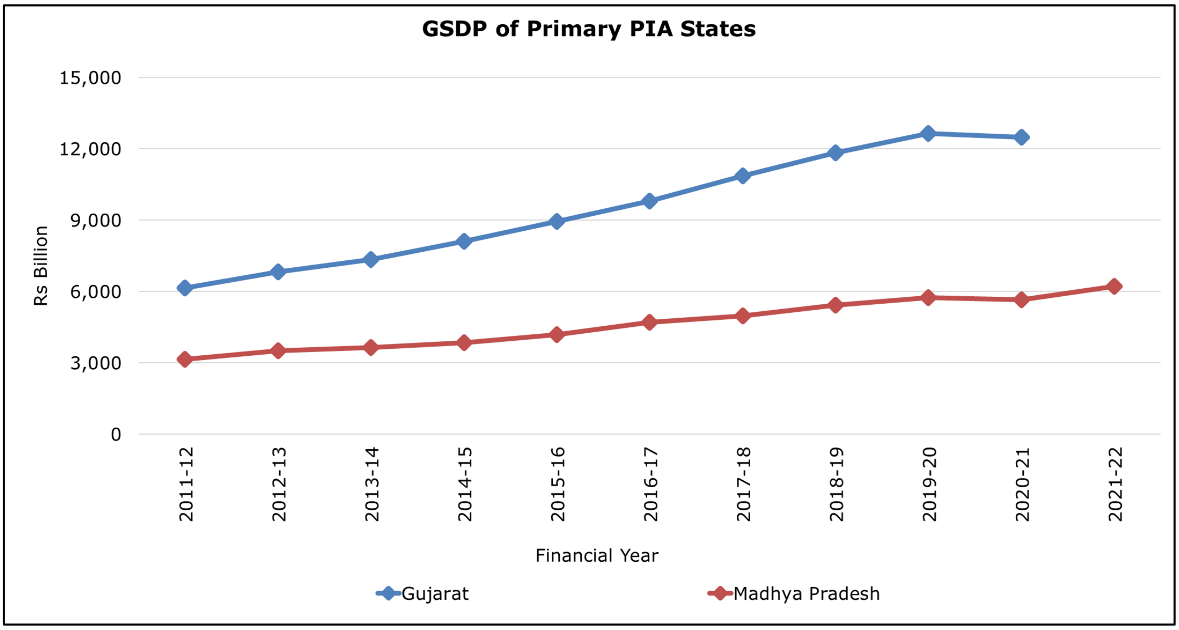


Figure 3-7: GSDP (in Rs Billion) for Influencing PIA States

3.6 India and PIA Outlook

3.6.1 India's past performance and outlook for future

India's growth trend during the recent years has been presented in **Figure 3-8**.

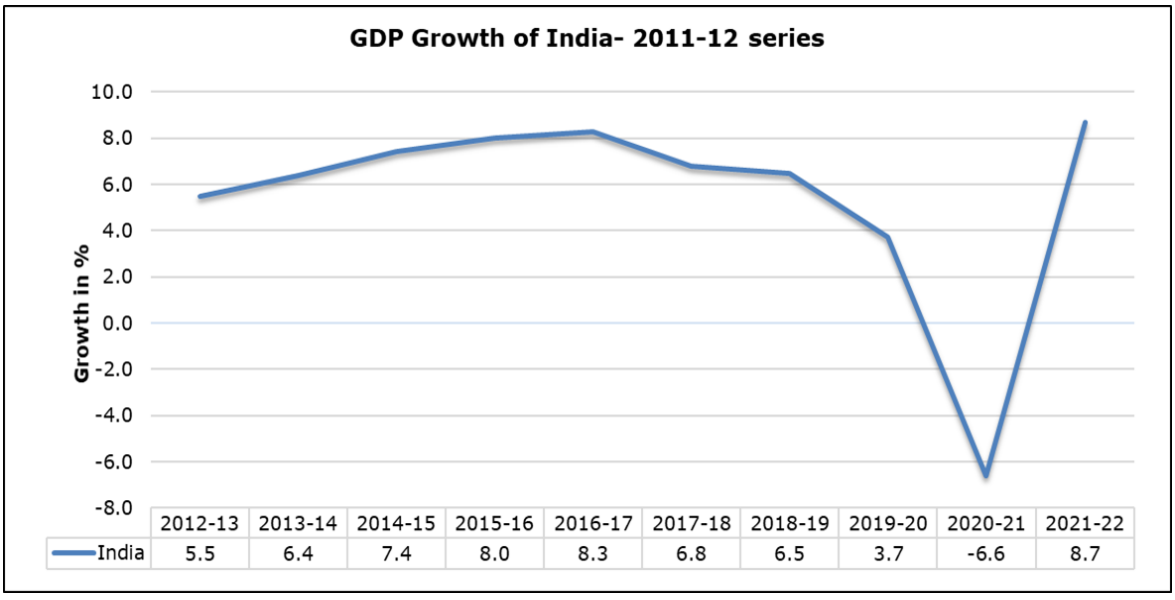


Figure 3-8: GDP Growth in India

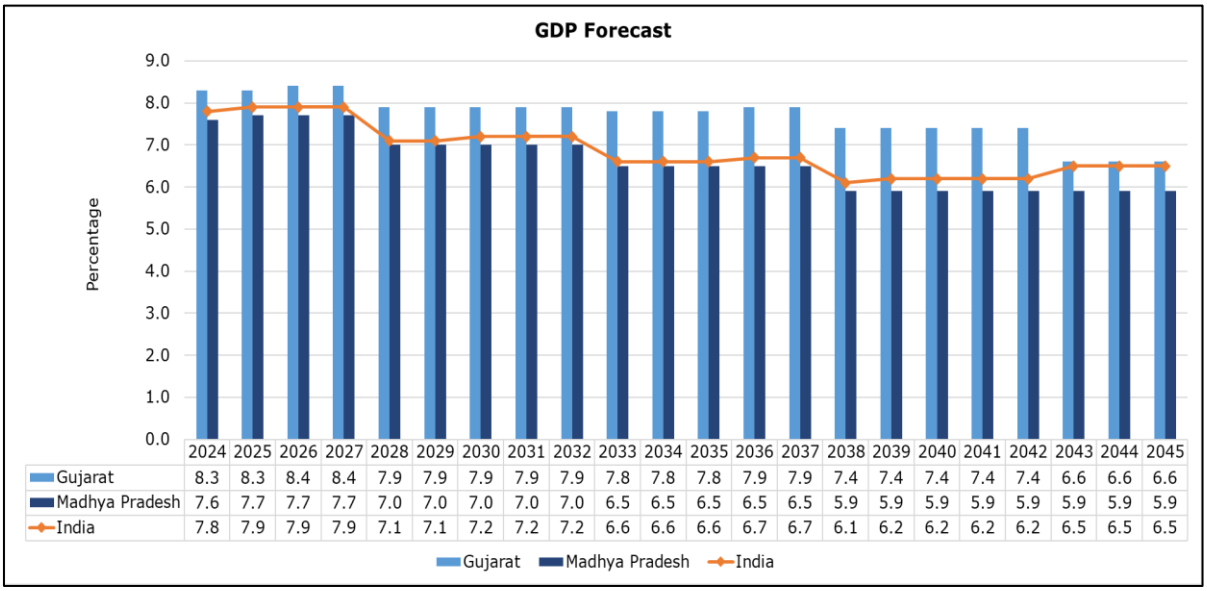
Economic growth in India has been broadly on an accelerating path till FY18. It is likely to be the fastest growing major economy in the world in the medium-term. The growth

in real GDP was 8.3 percent for FY17 and 6.8 percent in FY18, while the growth in FY19 was slightly lower at 6.5 percent. The long-term trend line growth of 7.2 percent has been achieved between FY12 to FY19. During FY20, growth has slowed down due to some structural issues and global headwinds resulting in an average GDP growth rate of 3.7 percent.

With the outbreak of COVID-19, global recession was witnessed across all the economies. The lockdown period announced by Indian government had an adverse impact on the economy. The first quarter estimated for FY21 has indicated a contraction of 23.9 percent, second quarter showed a rebound in growth by contracting 7.5 percent and third & fourth quarter grew by 0.5 percent and 1.6 percent respectively. The resultant contraction for FY21 has been 6.6 percent.

The Indian economy is likely to see the impact of global slowdown due to COVID-19 and hence, the GDP forecast for India by various international agencies has been revised for the next two years. As per the latest update by Central Statistical Organisation (CSO), GDP in FY22 has grown by 8.7 percent. As per Economic Survey of India for FY23, the economy is predicted to have a growth rate of 7.0 percent in FY23 and 6.0-6.8 percent in FY24. As per the latest forecast of RBI, the economy is likely to grow at 6.4 percent in FY24.

In light of the outlook being predicted by various agencies for the current years and likely revival thereafter spread over a couple of years, the year-on-year growth for Indian economy and PIA states as provided by the client from FY24 and beyond is presented in **Figure 3-9**.



	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045
Gujarat	8.3	8.3	8.4	8.4	7.9	7.9	7.9	7.9	7.9	7.8	7.8	7.8	7.9	7.9	7.4	7.4	7.4	7.4	7.4	6.6	6.6	6.6
Madhya Pradesh	7.6	7.7	7.7	7.7	7.0	7.0	7.0	7.0	7.0	6.5	6.5	6.5	6.5	6.5	5.9	5.9	5.9	5.9	5.9	5.9	5.9	5.9
India	7.8	7.9	7.9	7.9	7.1	7.1	7.2	7.2	7.2	6.6	6.6	6.6	6.7	6.7	6.1	6.2	6.2	6.2	6.2	6.5	6.5	6.5

Figure 3-9: GDP Forecast

3.6.2 PIA States Outlook

A snapshot of the main economic indicators in the past for the PIA states is presented in **Table 3-5**.

Indicators	Gujarat	Madhya Pradesh
GSDP in Rs Billion in FY20	12,652.8	5,755.5
GSDP growth (FY12 to FY20)	9.6	7.8
Per capita Income in Rs (FY20)	186,980	69,429
Sector Share (%) in FY20		
Agriculture and allied	17.2	35.2
Industry	46.3	25.9
Services	36.4	39.0

Table 3-5: Main Economic Indicators of PIA States

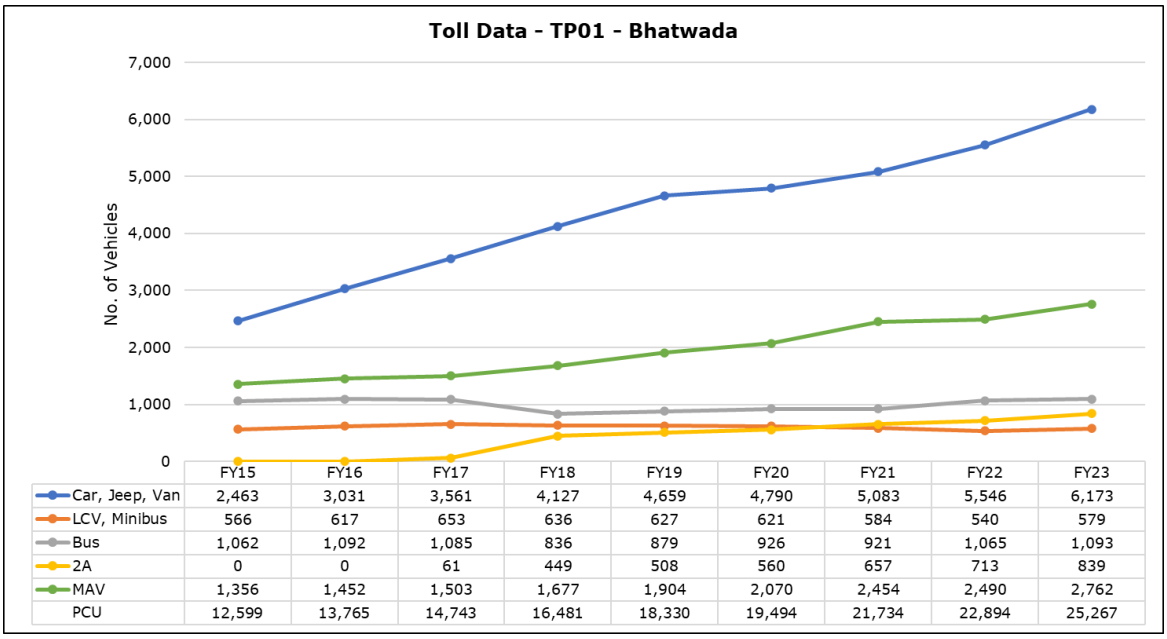
Based on the OD shares of the toll plaza location and the outlooks adopted for PIA states, the future weighted income for different vehicle types is presented in **Table 3-6**.

FY Ending March /Mode	Car/M LCV	LCV/M Bus	Bus	2A	3A/MAV
2024	8.3	8.2	8.3	8.2	8.2
2025	8.3	8.2	8.3	8.3	8.2
2026	8.4	8.3	8.4	8.3	8.3
2027	8.4	8.3	8.4	8.3	8.3
2028	7.9	7.8	7.9	7.8	7.8
2029	7.9	7.8	7.9	7.8	7.8
2030	7.9	7.8	7.9	7.8	7.8
2031	7.9	7.8	7.9	7.8	7.8
2032	7.9	7.8	7.9	7.8	7.8
2033	7.7	7.7	7.8	7.7	7.6
2034	7.7	7.7	7.8	7.7	7.6
2035	7.7	7.7	7.8	7.7	7.6
2036	7.8	7.8	7.9	7.8	7.7
2037	7.8	7.8	7.9	7.8	7.7
2038	7.3	7.3	7.4	7.3	7.2
2039	7.3	7.3	7.4	7.3	7.2
2040	7.3	7.3	7.4	7.3	7.2
2041	7.3	7.3	7.4	7.3	7.2
2042	7.3	7.3	7.4	7.3	7.2
2043	6.6	6.5	6.6	6.5	6.5
2044	6.6	6.5	6.6	6.5	6.5
2045	6.6	6.5	6.6	6.5	6.5

Table 3-6: Future Perspective of PIA Weighted Income

3.7 Review of Past Traffic Data

The toll plaza traffic data for the project road from the date of operation till FY23 was provided by the client. The past traffic data along with the FY23 AADT is presented in **Figure 3-10**.



	FY15	FY16	FY17	FY18	FY19	FY20	FY21	FY22	FY23
Car, Jeep, Van	2,463	3,031	3,561	4,127	4,659	4,790	5,083	5,546	6,173
LCV, Minibus	566	617	653	636	627	621	584	540	579
Bus	1,062	1,092	1,085	836	879	926	921	1,065	1,093
2A	0	0	61	449	508	560	657	713	839
MAV	1,356	1,452	1,503	1,677	1,904	2,070	2,454	2,490	2,762
PCU	12,599	13,765	14,743	16,481	18,330	19,494	21,734	22,894	25,267

Figure 3-10: Past Traffic Data at the Project Road

A time series analysis of the total traffic including exemptions and violations and a comparison of the yearly averages with FY23 is presented in **Table 3-7**.

FY Ending March \Mode	CJV	LCV/ M Bus	Bus	2A	MAV	PCU
Trend Line Growth						
FY15 vs FY23	11.2	-0.9	-0.3		9.9	9.2
FY17 vs FY23	8.7	-2.7	2.0	38.1	10.8	9.1
FY19 vs FY23	7.4	-2.9	5.9	13.3	9.7	8.4

Table 3-7: Past Growth and Trend Analysis

The comparison of the past toll data shows robust traffic growth in almost all the modes. The car traffic growth was in the range of 11-23 percent for the years until FY19. The slowdown in FY20 can be attributed to manufacturers deciding to reduce production of diesel cars in the near-future, technology disruption in the form of compliance to Bharat Stage VI norms, economic downturn and COVID 19. Later the growth in cars has been gradually picking up after FY20 and has shown a growth of about 9-11 percent between FY23 and FY21.

The Bus and Truck segregation is available from FY18. Buses have shown a growth of around 5.0 percent till FY20 after which a decline is observed due to Covid impact. However, FY22 onwards, actual bus traffic is also showing a pick-up in growth of around 16 percent and the absolute number of buses have reached the level of 2016. 2A trucks have a low base and have shown a double-digit growth in all the years since FY18.

In case of LCVs, negative growth is observed in the recent years between FY17 and FY22. On a general note, LCVs are showing negative growth in recent years which could be attributed to the tonnage shifts happening across all highways between the LCV category

from LCV to Mini LCV or could be a classification issue between LCVs and 2A trucks. FY22 and FY23 comparison shows a growth of 7.3 percent in LCVs.

High growth of 10.8 percent was observed in case of MAV in FY17 to FY23. The plausible reason for such high growth could be attributed to the opening of adjoining section from Gujarat/MP border to Indore after completion of upgradation to a four-lane facility.

On a broad level, the events which could have impacted the traffic growth on the PR is the completion of significant works on adjacent IVRCL stretch (Gujarat/MP border to Indore) in June 2016 and hence there was an increase in the traffic on the project road stretch. Also, upgradation works were carried out at Dahod-Banswara Road which is a feeder road to the project road to and from Rajasthan. The other main factors that might have impacted the traffic in the past include the impact of demonetisation in November 2016, GST in July 2017, all India truckers' strike in July 2018, revision of permissible Gross Vehicle Weights (GVW) for freight vehicle as per the new notification released by NHAI on 18th July,2018 and the impact of country wide/ state lockdowns starting from March 2020, FY21 and continuing in few months of FY22.

3.8 Past and Future Transport Demand Elasticity

The econometric model applied for the project, relates traffic growth to changes in state domestic product via an elasticity factor according to IRC guidelines. The elasticity by vehicle types have been estimated based on the regression analysis of weighted income of PIA states with the actual traffic data.

A regression between GSDP (as independent variable) and registered vehicles (as dependant variable) of PIA states was carried out for the state of Gujarat which showed an elasticity of 1.1 during the period between FY12 and FY19.

The best measure of deriving traffic elasticity to income is time series data of traffic on the road. In case of the project road, past traffic data is available since the year of operation of the toll plaza. The YOY mode wise traffic elasticity has been derived using rate of growth in the traffic vis a vis the rate of growth in income (weighted income derived from weighted OD shares). The elasticity estimates for different time periods have been done using regression analysis with mode wise traffic as dependent variable and weighted income as independent variable. The point to point and trend line actual elasticity between GSDP and traffic is presented in **Table 3-8**.

Period\Modes	Car / Jeep	LCV/Mbus	Bus	Truck	3A/MAV	Bus/Truck
Point to Point Elasticity						
FY16 vs FY15	2.3	0.9	0.3	0.0	0.7	0.3
FY17 vs FY16	1.8	0.6	-0.1	0.0	0.4	0.5
FY18 vs FY17	1.5	-0.3	-2.1	0.0	1.2	1.2
FY19 vs FY18	1.4	-0.2	0.6	1.5	1.5	0.9
FY20 vs FY19	0.4	-0.1	0.8	1.5	1.3	1.0
FY21 vs FY20	-4.5	4.3	0.4	-12.4	-13.0	-4.4

Period\Modes	Car / Jeep	LCV/Mbus	Bus	Truck	3A/MAV	Bus/Truck
FY22 vs FY21	0.9	-0.8	1.6	0.9	0.2	1.3
FY23 vs FY22	1.2	0.8	0.3	1.9	1.2	0.9
Trend Line Elasticity						
FY15 vs FY23	1.5	-0.1	-0.1		1.3	1.0
FY19 vs FY23	1.3	-0.4	0.2	5.3	1.5	1.3
FY20 vs FY23	1.2	-0.4	1.0	2.0	1.4	1.4

Table 3-8: Actual Past Traffic Elasticity

CJV

- The elasticities and the past growth levels for cars are a result of increasing income levels, increasing vehicle ownership and higher propensity to travel on highways in India due to network level developments and higher levels of service. These levels of growth are likely to continue in the near to medium term since car ownership levels are still very low and the road network is undergoing continual development. Actual trend line elasticity for the period FY15/ FY19 to FY23 has been varying between 1.2 to 1.5 in the past across the project road.
- It is likely that this growth would slow down over time as the market becomes more mature and saturated, therefore elasticity to GSDP can be expected to decline over time. CJV elasticity has been considered as 1.0 for the project road up to FY25 and tapered in subsequent years.
- The motorisation levels in India also play an important role in determining car growth. With the increasing car ownership levels, propensity to travel and network level improvements on National Highways, car growth is likely to be at a high rate as witnessed in the recent past. The low motorization rate suggests that there is room for continued growth for many years to come. With the continual increase in motorization rate and improved road network usage by cars for inter-urban travel, car growth is expected to be robust in India.

Bus

- Over the years in India there has been a change in passenger's travel mode preferences with increasingly more people shifting from public transport systems towards personalised modes. This has resulted, in general, elasticity of bus traffic/demand to GSDP being lower than unity.
- For future, 0.7 has been adopted for the project road and tapered for the rest of concession period.

Trucks

- The switch between MLCV and LCV is being observed across other national highways wherein MLCVs have been gaining importance lately over LCV category. Actual trend

line elasticity for LCV in FY15 to FY23 has been negative at the project road toll plaza. For future, 0.2 has been adopted for the toll plaza till the end of concession period.

- Elasticity of Bus/2 Axle trucks combined has been varying between 1.0-1.4 in FY15/FY17 to FY23. In light of these changing freight composition in the automobile industry and giving due consideration to the freight mix on the PR, an elasticity of 0.8 for 2A trucks has been adopted for the toll plaza and tapered thereafter.
- The elasticity values achieved in the past for 3A/MAV at is 1.3-1.4 while comparing FY23 with the recent past years. In case of MAV, an elasticity of 0.9 has been adopted for the plaza between FY23-FY25 and further on it has been tapered till the end of concession.

It is likely that this growth would slow down over time as the market becomes more mature and saturated, therefore elasticity to GSDP can be expected to decline over time. With the anticipated growth momentum in the coming years, higher elasticity values have been considered in the initial slabs for cars and further tapering has been done in the future slabs.

In India as a whole, the freight vehicle mix has been changing in the last decade favouring MAV to 2 Axle/ 3 Axle vehicles for long-distance traffic, given the operational efficiencies achievable with larger vehicles. Considering the ongoing technical advancements in automobile industry, some of the standard 2 Axle/ 3 Axle trucks would gradually be replaced by MAVs. Mature national highways with tolling in operation for few years, have already witnessed the shift in 2A/3A trucks to MAV for long distance movement. As per the latest industry trends, there is a shift happening between various categories of MAVs also - 4A, 5A and 6A and above. 4A trucks are likely to see a replacement soon to 5A and above axle trucks which can carry more tonnage as compared to 4A trucks.

On an overall level, due consideration has been given to the tonnage shifts happening in the market with Mini LCV gaining importance for short distance movements over LCVs and MAVs being preferred over 2A/3A for long distance movements due to better operational efficiencies. Some of the 2A/3A trucks are also being used for local movements.

Giving due consideration to the growth momentum being witnessed in the immediate past, higher elasticity values have been considered for the slab up to FY25 and further tapering has been done in the next slab. The recommended elasticity values adopted for all vehicle types in line with the past traffic data and changes in freight traffic pattern observed on the project road are presented in **Table 3-9**.

Period \Modes	Car/MLCV	LCV/M Bus	Bus	Truck	3A/MAV
Up to 2025	1.0	0.2	0.7	0.8	0.9
2025-2030	0.9	0.2	0.6	0.7	0.8
2030-2035	0.8	0.2	0.5	0.6	0.7

Period \Modes	Car/MLCV	LCV/M Bus	Bus	Truck	3A/MAV
Beyond 2035	0.7	0.2	0.5	0.5	0.6

Table 3-9: Recommended Elasticity for Project Road

The above recommended elasticity values have been used to arrive at traffic growth rates.

3.9 Projected Traffic Growth Rates

Based on the moderated perspective elasticity values and the projected growth rates of the income for PIA states, the future average annual compound traffic growth rates by vehicle type have been estimated for the project road by using the following relationship:

$T_{gr} = (GSDP_{gr}) \times E$

Where,

T_{gr} – Traffic growth rate for mode

$GSDP_{gr}$ – Growth rate of GSDP

E – Elasticity value for mode

The estimated traffic growth rates for the project road have been presented in **Table 3-10**.

FY Ending March/ Modes	Car/MLCV	LCV/M Bus	Bus	2A	3A/MAV
2024	8.3	1.6	5.8	6.6	7.4
2025	8.3	1.6	5.8	6.6	7.4
2026	7.5	1.7	5.0	5.8	6.6
2027	7.5	1.7	5.0	5.8	6.6
2028	7.1	1.6	4.7	5.5	6.2
2029	7.1	1.6	4.7	5.5	6.2
2030	7.1	1.6	4.7	5.5	6.2
2031	6.3	1.6	3.9	4.7	5.4
2032	6.3	1.6	3.9	4.7	5.4
2033	6.2	1.5	3.9	4.6	5.3
2034	6.2	1.5	3.9	4.6	5.3
2035	6.2	1.5	3.9	4.6	5.3
2036	5.5	1.6	3.9	3.9	4.6
2037	5.5	1.6	3.9	3.9	4.6
2038	5.1	1.5	3.7	3.6	4.3
2039	5.1	1.5	3.7	3.6	4.3
2040	5.1	1.5	3.7	3.6	4.3
2041	5.1	1.5	3.7	3.6	4.3
2042	5.1	1.5	3.7	3.6	4.3
2043	4.6	1.3	3.3	3.3	3.9
2044	4.6	1.3	3.3	3.3	3.9
2045	4.6	1.3	3.3	3.3	3.9

Table 3-10: Projected Traffic Growth Rates for the Project Road (%)

In derivation of above growth rates, the likely shift of buses to cars in case of passenger vehicles and the replacement/ tonnage shift of LCV/3A trucks by Mini LCV/2A truck for short distance and MAV for long distance in case of freight vehicles has been duly considered.

3.10 Modifications in Concession Period and Capacity Analysis

Table 3-11 presents the projections of the total traffic at the toll plaza on the project road using the above traffic growth rates till the end of concession as assessed in this study.

FY End	Projected PCUs
2023	25,267
2024	27,065
2025	28,999
2026	30,863
2027	32,851
2028	34,839
2029	36,952
2030	39,196
2031	41,281
2032	43,480
2033	45,760
2034	48,163
2035	50,696
2036	53,056
2037	55,528
2038	57,949
2039	60,477
2040	63,119
2041	65,878
2042	68,760
2043	71,470
2044	74,288

Table 3-11: Projected Total Traffic at Toll Plaza (Including non tollable)

The target traffic as per Concession Agreement is deemed to be 26,839 PCUs as on 1st October 2019. The traffic volume counts reported as per the surveys conducted in September 2018, September 2019 and September 2020 are 17,017 PCUs, 17,891 PCUs and 21,525 PCUs respectively. The traffic estimated on the project road as an average of these surveys is 18,881 PCUs which is 29 percent lower than the target traffic.

Based on the CA (clause 29.2.1), if the traffic in PCUs at target date is lower than the target traffic, then for every 1 percent decrease, the concession period shall be increased by 1.5 percent, and not more than 20 per cent of the base concession period.

As per information provided by the Concessionaire, IE and NHAI PIU has already recommended for extension of concession period by 5.4 years.

The projected traffic on the section will reach the designed capacity of 60,000 PCU during FY39 wherein the DPR preparation for capacity augmentation to six laning may get initiated by NHAI.

4. TOLL REVENUE PROJECTIONS

4.1 Tolling Strategy

The project road has an "Open System" of toll collection which enables the concessionaire to collect tolls from through traffic as well as from short distance one.

As mentioned earlier, there is one operational toll plaza at km 146.500 (Bhatwada Toll Plaza) where toll collection started from November 2013 for a normal tolling length of 87.102 km. In addition, Limkheda bypass and a ROB at km 144 are being charged at structure rate with cost of Rs 60.60 crore and Rs 55 crore respectively.

4.2 Schedule of User Fee

As per Schedule of User Fee (Schedule R) of Concession Agreement for the project, the per km toll rates applicable from 2007/08 for normal tolling length and permanent structures, the revision basis and concessions are provided.

The concessions to traffic have been given in the form of rates as below:

Local traffic

Car / Jeep / Vans - includes local users owning a vehicle registered for non-commercial purposes, residing within a distance of 20 km from the toll plaza and crossing the same for commuting purposes. The discounted fee for these users shall be a monthly pass of Rs. 150.00.

Daily Pass

When the vehicle has to cross the tolled section more than once in a day, the user shall have the option to pay one and half times (1.5 times) of the fee for a single entry; this pass shall be valid for 2 entries within 24 hours of purchase.

Monthly Pass

A user, who makes use of the project road frequently during a month, may opt to purchase a monthly pass upon payment of a charge equal to two-thirds of the fee payable for 50 single journeys; this pass can be used for a maximum 50 one-way journeys over the month of validity.

Thus, the different categories of toll tickets are as follows:

(i) Traffic paying normal toll rates (single trip)
(ii) Traffic paying return journey rates
(iii) Traffic paying monthly pass rates
(iv) Traffic paying local personal rates

4.3 Tolling Streams

The toll data giving the bifurcation of normal paying traffic and the traffic opting for concessions has been provided since the time of operation. In line with the categories of toll payments, a segmentation of total paying traffic was analysed from the toll data for all the past years. The tolling stream distribution over the years has been similar.

The tolling stream distribution derived from the toll plaza data by taking the average from FY23 (April to March) has been adopted for the present study and is presented in **Table 4-1**.

Category/Modes	Car/ MLCV	LCV/ Mini-Bus	Bus	Truck	3A/MAV	OSV
Normal Toll Paying Traffic	38.2	52.6	11.4	69.5	89.3	100.0
Daily Pass Traffic	38.1	43.8	88.4	27.3	10.5	
Monthly Pass Traffic	0.0	0.1	0.0	0.0	0.1	
Local Pass Traffic	15.2	0.0	0.0	0.0	0.0	
Local Commercial One time	0.1	0.1	0.0	2.4	0.0	
Exemption and violation	8.5	3.4	0.2	0.7	0.1	
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Table 4-1:Tolling Distribution for the PR Including Exemptions and Violations (in %)

As observed from the tolling stream distribution, the non-paying traffic (exemptions and violations) in case of cars is around 8.5 percent and around 3.4 percent is observed in LCV/M Bus category. It is minimal in case of other categories.

The tolling distribution presented in **Table 4-1** is of the total traffic captured on road including the exempted vehicles which do not pay toll at the toll plaza location. The paying traffic for the year FY23 has been worked out by deducting the toll exempt percentage (exemptions, FY23) from total AADT and is presented in **Table 4-2**.

Toll Plaza/Modes	Car/ MLCV	LCV/ Mini Bus	Bus	Truck	3A/MAV	OSV	PCUs
Base AADT including exemptions and violations	6,173	579	1,093	839	2,751	11	25,267
% of Exemptions and violations	8.5%	3.4%	0.2%	0.7%	0.1%	0.0%	
Paying Traffic	5,646	559	1,091	833	2,747	11	24,667

Table 4-2: Toll Paying Traffic, FY23

The normalised tolling stream distribution for the toll plaza excluding the exempt vehicles for the FY23 is presented in **Table 4-3**.

Category/Modes	Car/ MLCV	LCV/ Mini-Bus	Bus	Truck	3A/MAV	OSV
Normal Toll	41.6	54.5	11.4	70.0	89.4	100.0
Daily Pass	41.7	45.3	88.6	27.5	10.5	0.0

Category/Modes	Car/ MLCV	LCV/ Mini-Bus	Bus	Truck	3A/MAV	OSV
Monthly Pass	0.0	0.1	0.0	0.0	0.1	0.0
Local Concessions	0.0	0.1	0.0	0.0	0.1	0.0
Local Commercial One time	16.6	0.0	0.0	0.0	0.0	0.0
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Table 4-3: Tolling Distribution for the Project Road Excluding Exemptions and Violations (in %)

Car traffic opting for normal ticket and daily pass is about 42 percent each followed by local concession one time ticket with a share of about 17 percent. While about 89 percent of bus traffic is falling under daily pass category followed by about 12 percent falling under normal ticket.

In case of freight traffic, more than 70 percent of Trucks/ 3A/MAVs are opting for normal ticket. In case of daily passes around 45 percent of LCVs, 28 percent of trucks and 10 percent of 3A/MAVs are likely to fall under this category.

For monthly passes, given the Schedule of User Fee cap on multiple entries with a single pass, a trip rate of 1.67 trips per day has been assumed for all vehicle types. For daily pass, based on the toll data a trip rate of 2 has been used for the various toll categories of vehicles.

4.4 Toll Rates

This section presents details on the toll rates that are likely to be imposed on the users of the project road during the concession period. The toll rates (Rs/km) for the base year 2007-08 for different vehicle categories as per concession agreement are presented in **Table 4-4**.

Mode	Base rate per km (in Rs)
Car/MLCV	0.65
LCV/Mini Bus	1.05
Bus/Truck	2.20
3-axle Truck/MAV	3.45
OSV	4.20
Local Passenger Traffic	150

Table 4-4: Toll Rates in Rs/km for Different Vehicle Categories

The CA states that the 2007 toll rates shall be increased without compounding by three per cent each year with effect from the 1st day of April 2008 and such increased rate shall be deemed to be the base rate for the subsequent years.

In addition to this, the rate of fee for use of bypass forming part of a section of a National Highway constructed with a cost of Rs 10 crore or more, for the base year 2007, shall be one and a half times of the per km base rates specified above and the length of such bypass shall be excluded from the length of such section of National Highway.

Additionally, when permanent structures such as bridges, tunnels or flyovers are part of the project road and their construction cost exceeds 500 million Rs (50 Crore), then the length of such structures shall be deducted from the tolling length and the structure tolled according to the rates presented in **Table 4-5**.

Cost of Structure (Rupees in crore)	Car, Jeep, Van or Light Motor Vehicle	LCV, Light Goods Vehicle or Mini-Bus	Truck or Bus	HCM, EME,3A or MAV	Over size Vehicle
10 to 15	5	7.5	15	22	30
For every additional rupees five crore or part thereof, exceeding rupees fifteen crore and up to rupees one hundred crore.	1	1.5	3	4.5	6
For every additional rupees five crore or part thereof, exceeding rupees one hundred crore and up to rupees two hundred crore.	0.8	1.2	2.3	3.4	4.5
For every additional rupees five crore or part thereof, exceeding rupees two hundred crore.	0.5	0.8	1.5	2.3	3

Table 4-5: Toll Rates in Rs for Permanent Structure Exceeding 500 Million Rs Cost

In case of the project road, Limakheda bypass with a cost of Rs 60.6 crore and a ROB at km 144.000 with structure cost of Rs 55.0 crore is being charged at the toll plaza along with base highway section.

The applicable base rates shall be revised annually with effect from April 1 each year to reflect the increase in wholesale price index for the month of December of the immediate preceding year in which sub revision is undertaken but such revision shall be restricted for 40 per cent of the increase in wholesale price index.

Actual WPI information for December 2021 of 150.4 under 2011-12 series converted into 1993-94 series (462.3) has been used. The forecast for WPI as provided by the client has been used for the period till the end of concession period (extended) and is presented in **Table 4-6**.

December in FY End	Applicable for FY	WPI Forecast
2024	2025	4.40
2025	2026	4.77
2026	2027	4.95
2027	2028	5.04
2028	2029	5.26
2029	2030	5.37
2030	2031	5.43
2031	2032	5.28
2032	2033	5.21
2033	2034	5.00
2034	2035	4.90
2035	2036	4.67

December in FY End	Applicable for FY	WPI Forecast
2036	2037	4.56
2037	2038	4.25
2038	2039	4.09
2039	2040	3.84
2040	2041	3.72
2041	2042	3.72
2042	2043	3.72
2043	2044	3.72

Table 4-6: WPI Forecast for Toll Rate Indexation

The stream of toll rates to be charged at the toll plaza for cardinal years is presented in **Table 4-7**. The toll fee has been rounded to nearest 5 Rupees as per Schedule R of the concession agreement.

FY Ending March	Car/ MLCV	LCV/ Mini Bus	Bus/ Truck	3A-Truck/ MAV	OSV	Local monthly pass for Cars
2023	165	260	535	830	1,040	315
2025	180	285	590	910	1,145	345
2030	235	370	760	1,175	1,475	445
2035	305	480	985	1,520	1,915	575
2038	350	555	1,140	1,760	2,210	665
2044	455	720	1,480	2,285	2,870	865

Table 4-7: Toll Rates at the Toll Plaza (in Rs)

The users purchasing return journey tickets will pay 1.5 times the above toll rates; the traffic opting for monthly passes will pay 33.3 times (two-thirds of 50 single journeys) the normal traffic toll rates. Local commercial vehicles registered in the district of toll plaza will pay 50 percent of a single journey ticket. All passes have been rounded to the nearest 5 Rupees as per concession agreement.

4.5 Projected Tollable Traffic

The projected toll paying traffic in PCUs (excluding exemptions and violations) based on the traffic growth rates till the end of concession as assessed in this study is presented in **Table 4-8**.

FY Ending March	Tollable Traffic in PCU
2023	24,667
2024	26,420
2025	28,302
2026	30,116
2027	32,051
2028	33,985
2029	36,039
2030	38,221
2031	40,248
2032	42,385

FY Ending March	Tollable Traffic in PCU
2033	44,599
2034	46,933
2035	49,392
2036	51,683
2037	54,082
2038	56,431
2039	58,884
2040	61,446
2041	64,122
2042	66,917
2043	69,543
2044	72,276

Table 4-8: Projected Toll Paying Traffic in PCUs at the Toll Plaza

4.6 Toll Revenue Estimates

The concession period for the project road is 27 years from the appointed date (the date financial close is achieved). Toll revenue realised for FY23 is Rs 1,430.7 million.

Toll revenue streams have been calculated assuming that:

- Toll would be collected for all 365 days in a year; however, for leap year, 366 days have been used
- Tolling started in November 2013
- Tolling would terminate on 23rd July 2043 (original concession end date is 28th February 2038) in view of the extension of concession period for 5.4 years due to target traffic provisions. However, revenues have been presented for full year of FY44.

A mode wise breakdown of the revenue streams is also presented for the project road in **Table 4-9**.

FY Ending March	Car/ MLCV	LCV/ Mini Bus	Bus	Truck	3A-Truck/ MAV	OSV	Total
2023 (Actual)	254.8	47.0	166.2	149.5	809.3	3.9	1,430.7
2024	290.4	50.6	185.3	168.6	914.4	4.7	1,614.0
2025	326.5	53.4	204.7	187.3	1,024.3	5.3	1,801.5
2026	367.7	57.0	225.9	208.3	1,146.6	5.9	2,011.4
2027	416.2	61.0	248.8	231.1	1,286.4	6.7	2,250.2
2028	469.3	65.2	275.9	257.8	1,438.7	7.5	2,514.3
2029	528.4	69.7	302.3	284.8	1,603.7	8.3	2,797.3
2030	598.6	74.9	334.2	317.1	1,802.5	9.3	3,136.7
2031	667.5	80.2	367.0	349.8	1,998.2	10.3	3,473.0
2032	752.6	85.8	403.3	387.7	2,232.0	11.5	3,873.0
2033	840.9	91.4	439.3	425.9	2,470.4	12.7	4,280.6
2034	944.2	97.8	480.6	470.2	2,735.2	14.2	4,742.1
2035	1,052.0	104.6	525.6	516.1	3,030.4	15.7	5,244.4

FY Ending March	Car/ MLCV	LCV/ Mini Bus	Bus	Truck	3A-Truck/ MAV	OSV	Total
2036	1,170.3	111.5	575.6	564.9	3,346.5	17.3	5,786.1
2037	1,291.8	119.2	627.5	616.1	3,666.3	18.9	6,339.7
2038	1,416.1	126.7	680.5	667.8	4,006.6	20.7	6,918.5
2039	1,567.8	134.5	738.8	725.2	4,369.5	22.6	7,558.6
2040	1,723.3	142.6	802.2	785.8	4,781.4	24.7	8,260.0
2041	1,880.9	150.4	867.1	848.2	5,193.5	26.8	8,967.0
2042	2,076.3	159.9	938.6	919.1	5,647.8	29.2	9,771.0
2043	2,253.4	169.0	1,012.3	991.1	6,133.2	31.7	10,590.7
2044*	2,471.7	179.2	1,092.8	1,069.7	6,667.6	34.5	11,515.4

*-presented for full year of FY44

Table 4-9: Toll Revenue (in Rs million) for Project Road by Mode

Majority of the revenue is expected to come from 3A/MAV with about 57.6 percent of the total revenue. Amongst other categories, Car/MLCV represent a share of around 19.6 per cent of total revenue followed by Bus/2A Truck at about 10 percent each. LCV/Mini-Bus category is likely to generated about 2.2 percent revenue.

While in case of ticket wise revenue streams, almost entire share of revenue is likely to be generated from normal toll and return passes contributing about 74.6 percent and 24.8 percent respectively. The monthly pass and local concession category are likely to generate 0.6 percent of revenue of the project road.

The project road has a revenue CAGR of 10.4 percent during the tenure of concession.

APPENDICES

APPENDIX 2.1
TRAFFIC ZONING SYSTEM

Traffic Study for Godhra-GJ/MP Border Section of NH-47 in the State of Gujarat

Traffic Zoning System

Zone	Place/Region	District/ State	State
1	Paravdi/Chundadi/Chanchelav	Project Corridor : Godhra-GJ/MP Border	Gujarat
2	Ladpur		
3	Santroad/Orwara		
4	Piplod		
5	Limkheda		
6	Dhadhela/Dabhada/Valundi		
7	Jekot/Rampura		
8	Garbada		
9	Dahod		
10	Katwara/ Kathla		
11	Varvada/Khangela		
12	Godhra	Panch Mahal District	
13	Shehera/Vijapur/Morva/Mora/Suliyat/Dalvada (Central and North Panchamahal)		
14	Halol/Champaner		
15	Kalol/Ghoghamba/Vyasda/Jambhughoda/Shivrajpur/Pavagad (South PanchMahal)		
16	Santrampur	Mahisagar District	
17	Lunavada/Limadiya/Bakor/Viraniya		
18	Limdi/Jhalod/Kadana/Rest of North Dahod District	Dahod District	
19	Devgadh Baria/Dhanpur		
20	Garbada		
21	Savli/Desar/Tulsigan/Champaner (North Vadodara)	Vadodara District	
22	Vadodara city		
23	Karjan/Dabhoi/Waghodia/Jambusar (Rest of Vadodara district)		
24	Chhota Udepur/Panvad/kavant	Chhota Udepur District	
25	Nadiad	Kheda District	
26	Kheda City		
27	Mahudha/Sihuj/Mehmedobad/Matar/Alina/Navagam/Thasra/Dakor (South Kheda)		
28	Kathlal/Ghodasar/Haldalvas/Aantarsubha/Ghodasar/Lasundra/Ladvel (Central Kheda)		
29	Kapadwanj/Balasinor/Pandva/Bar/Virpur/Sanoda/Vadadala/Utkanteshwar (North Kheda)		
30	Khedbrahma/Vijaynagar/Vadali/Idar/Bhiloda(North Sabarkantha)	Sabarkantha	
31	Modasa/Bayad/Malpur/Dhansura/Meghraj (South Sabarkantha)		
32	Himmatnagar/Prantij/Talod (West Sabarkantha)		
33	Anand	Anand	
34	Borsad/Tarapur/Khambhat/Rest of Anand		
35	Ahmedabad City	Ahmedabad District	
36	Dholka/Koth/Bagodra/Vataman/Dhandhuka/Ranapur/Fadra/Pipli (South Ahmedabad)		
37	Bavla/Nalsarovar/Vatva/Jetalpur/Sanand/Angraj (Central Ahmedabad)		
38	Viramgam/Khorej/Rampura/Mandal/Detroj (Northen Ahmedabad)		
39	Gandhinagar	Gandhinagar District	
40	Sabarmati		
41	Dehgam/Bahiyal/Rakhlal/Dhaboda/Chiloda (East Gandhinagar)		
42	Chhala/Randhaja/Mansa/Rest of Gandhinagar		
43	Palanpur/Mehsana/Banaskantha/Patan/Rann of Kutch(North Gujarat)	North of Gujarat	
44	Surat/Hazira	South East of Gujarat	
45	Bharuch/Narmada/Tapi/Navsari/The Dangs/Valsad/Rest of South East Gujarat	South East of Gujarat	
46	Kandla/Mundra/Gandhidham/Bhuj (West Gujarat)	West Gujarat	
47	Surendranagar, Bhavnagar, Rajkot, Jamnagar, Porbandar, Amreli, Junagadh (South West Gujarat)	South west Gujarat	
48	Jhabua/Nawagaon/Ranapur	Jhabua District (MP)	Madhya Pradesh
49	Megh Nagar/Thandla/Petlawad		
50	Alirajpur / Bhabra / Jobat	Alirajpur District (MP)	
51	Ratlam / Jaora / Bajna / Alot / Piploda / Bajna / Nagda	Ratlam District (MP)	
52	Dhar / Rajgarh / Sardarpur / Gandhwani / Badnawar	Dhar District (MP)	
53	Pithampur/ Mhow (Dr. Ambedkar Nagar)	Indore District (MP)	
54	Indore / Dewas		
55	Bhopal	Bhopal District (MP)	
56	Ujjain/Depalpur	Ujjain District (MP)	
57	Khandwa,Khargone	Madhya Pradesh	
58	Biaora/Shajapur/Rajgarh	Madhya Pradesh	
59	Gwalior/Guna/Sagar/Chhindwara/Jabalpur/Katni/Rewa/Satna/Rest of Madhya Pradesh	Madhya Pradesh	
60	Jodhpur/Bikaner/Jaisalmer/Churu/Hanumangarh	Western Rajasthan	Rajasthan
61	Jaipur/Alwar/Bharatpur/Bhilwara/Chittorgarh/Udaipur/Banswara/Kota	Eastern Rajasthan	
62	Mumbai / Mumbai JNPT / Nashik	Maharashtra	Maharashtra
63	Pune/ Jalgaon / Dhule /Aurangabad		
64	Nagpur/Bhandara/Amravati/Rest of Maharashtra		
65	Chattisgarh	Chattisgarh	Chattisgarh
66	Delhi	Delhi	Delhi
67	Agra/Mathura/Meerut/Muzaffarnagar/Bareily	Western Uttar Pradesh	Western Uttar Pradesh
68	Uttar Pradesh	Uttar Pradesh	
69	Punjab	Punjab	Punjab
70	Haryana	Haryana	Haryana
71	Jammu & Kashmir/Himachal Pradesh/Uttarakhand	Jammu & Kashmir/Himachal Pradesh/Uttarakhand	Jammu & Kashmir/Himachal Pradesh/Uttarakhand
72	West Bengal	West Bengal	West Bengal
73	Bihar	Bihar	Bihar
74	Jharkand	Jharkand	Jharkand
75	Odisha	Odisha	Odisha
76	Assam,Sikkim,Tripura,Nagaland,Arunachal Pradesh, Manipur	North Eastern States	North Eastern States
77	Karnataka/Andhra Pradesh/Telangana/Tamil Nadu/Kerala	South Indian States	South Indian States

APPENDIX 2.2
MODE WISE TOP 20 OD PAIRS

Traffic Study for Godhra-GJ/MP Border Section of NH-47 in the State of Gujarat

Top 20 Origin Destination Pairs at TP01-Bhatwada Toll Plaza

Car/ Jeep

S.No.	Origin	Destination	% of total
1	Dahod	Godhra	18%
2	Piplod	Godhra	8%
3	Dahod	Vadodara city	5%
4	Limkheda	Godhra	4%
5	Dahod	Ahmedabad City	3%
6	Dahod	Halol/Champaner	2%
7	Santroad/Orwara	Dahod	2%
8	Santroad/Orwara	Piplod	2%
9	Godhra	Limdi/Jhalod/Kadana/Rest of North Dahod District	2%
10	Dahod	Surat/Hazira	2%
11	Dahod	Surendranagar, Bhavnagar, Rajkot, Jamnagar, Porbandar, Amreli, Junagadh (South West Gujarat)	2%
12	Godhra	Devgadh Baria/Dhanpur	1%
13	Dahod	Nadiad	1%
14	Limkheda	Halol/Champaner	1%
15	Surat/Hazira	Indore / Dewas	1%
16	Piplod	Ahmedabad City	1%
17	Dahod	Bharuch/Narmada/Tapi/Navsari/The Dangs/Valsad/Rest of South East Gujarat	1%
18	Piplod	Halol/Champaner	1%
19	Vadodara city	Indore / Dewas	1%
20	Ahmedabad City	Indore / Dewas	1%
		Total	**58%**

Bus

S.No.	Origin	Destination	% of total
1	Dahod	Godhra	23%
2	Dahod	Surat/Hazira	8%
3	Dahod	Bharuch/Narmada/Tapi/Navsari/The Dangs/Valsad/Rest of South East Gujarat	4%
4	Dahod	Ahmedabad City	4%
5	Dahod	Vadodara city	3%
6	Limdi/Jhalod/Kadana/Rest of North Dahod District	Surat/Hazira	3%
7	Godhra	Devgadh Baria/Dhanpur	3%
8	Limdi/Jhalod/Kadana/Rest of North Dahod District	Vadodara city	2%
9	Limdi/Jhalod/Kadana/Rest of North Dahod District	Surendranagar, Bhavnagar, Rajkot, Jamnagar, Porbandar, Amreli, Junagadh (South West Gujarat)	2%
10	Limdi/Jhalod/Kadana/Rest of North Dahod District	Ahmedabad City	2%
11	Godhra	Limdi/Jhalod/Kadana/Rest of North Dahod District	2%
12	Dahod	Kheda City	2%
13	Dahod	Bavla/Nalsarovar/Vatva/Jetalpur/Sanand/Angraj (Central Ahmedabad)	2%
14	Dahod	Anand	2%
15	Dahod	Surendranagar, Bhavnagar, Rajkot, Jamnagar, Porbandar, Amreli, Junagadh (South West Gujarat)	1%
16	Limdi/Jhalod/Kadana/Rest of North Dahod District	Nadiad	1%
17	Dahod	Nadiad	1%
18	Piplod	Surat/Hazira	1%
19	Dahod	Mahudha/Sihuj/Mehmedobad/Matar/Alina/Navagam/Thasra/Dakor (South Kheda)	1%
20	Godhra	Chhota Udepur/Panvad/kavant	1%
		Total	**68%**

Traffic Study for Godhra-GJ/MP Border Section of NH-47 in the State of Gujarat

Top 20 Origin Destination Pairs at TP01-Bhatwada Toll Plaza

LCV

S.No.	Origin	Destination	% of total
1	Dahod	Godhra	10%
2	Dahod	Vadodara city	5%
3	Dahod	Ahmedabad City	4%
4	Piplod	Godhra	4%
5	Vadodara city	Indore / Dewas	3%
6	Ahmedabad City	Indore / Dewas	3%
7	Limkheda	Godhra	3%
8	Dahod	Halol/Champaner	2%
9	Surat/Hazira	Indore / Dewas	2%
10	Godhra	Indore / Dewas	2%
11	Vadodara city	Bhopal	2%
12	Dahod	Surat/Hazira	2%
13	Ahmedabad City	Bhopal	2%
14	Godhra	Uttar Pradesh	1%
15	Dahod	Surendranagar, Bhavnagar, Rajkot, Jamnagar, Porbandar, Amreli, Junagadh (South West Gujarat)	1%
16	Piplod	Vadodara city	1%
17	Dahod	Anand	1%
18	Dahod	Shehera/Vijapur/Morva/Mora/Suliyat/Dalvada (Central and North Panchamahal)	1%
19	Dahod	Bharuch/Narmada/Tapi/Navsari/The Dangs/Valsad/Rest of South East Gujarat	1%
20	Godhra	Limdi/Jhalod/Kadana/Rest of North Dahod District	1%
		Total	**52%**

Truck

S.No.	Origin	Destination	% of total
1	Dahod	Surat/Hazira	8%
2	Dahod	Ahmedabad City	7%
3	Dahod	Godhra	5%
4	Ahmedabad City	Indore / Dewas	4%
5	Dahod	Surendranagar, Bhavnagar, Rajkot, Jamnagar, Porbandar, Amreli, Junagadh (South West Gujarat)	4%
6	Dahod	Vadodara city	4%
7	Piplod	Godhra	4%
8	Surendranagar, Bhavnagar, Rajkot, Jamnagar, Porbandar, Amreli, Junagadh (South West Gujarat)	Indore / Dewas	3%
9	Vadodara city	Indore / Dewas	3%
10	Limkheda	Godhra	3%
11	Surat/Hazira	Indore / Dewas	2%
12	Dahod	Bharuch/Narmada/Tapi/Navsari/The Dangs/Valsad/Rest of South East Gujarat	2%
13	Limdi/Jhalod/Kadana/Rest of North Dahod District	Surendranagar, Bhavnagar, Rajkot, Jamnagar, Porbandar, Amreli, Junagadh (South West Gujarat)	2%
14	Dahod	Mumbai / Mumbai JNPT / Nashik	2%
15	Indore / Dewas	Mumbai / Mumbai JNPT / Nashik	2%
16	Limdi/Jhalod/Kadana/Rest of North Dahod District	Vadodara city	1%
17	Vadodara city	Uttar Pradesh	1%
18	Ahmedabad City	Agra/Mathura/Meerut/Muzaffarnagar/Bareily	1%
19	Godhra	Indore / Dewas	1%
20	Dahod	Halol/Champaner	1%
		Total	**60%**

MAV

S.No.	Origin	Destination	% of total
1	Ahmedabad City	Indore / Dewas	6%
2	Dahod	Surat/Hazira	4%
3	Dahod	Ahmedabad City	4%
4	Surat/Hazira	Indore / Dewas	4%
5	Dahod	Vadodara city	3%
6	Surat/Hazira	Bhopal	2%
7	Surat/Hazira	Uttar Pradesh	2%
8	Dahod	Godhra	2%
9	Ahmedabad City	Bhopal	2%
10	Limkheda	Surat/Hazira	2%
11	Bharuch/Narmada/Tapi/Navsari/The Dangs/Valsad/Rest of South East Gujarat	Indore / Dewas	2%
12	Godhra	Indore / Dewas	2%
13	Vadodara city	Uttar Pradesh	2%
14	Surat/Hazira	Megh Nagar/Thandla/Petlawad	1%
15	Dahod	Surendranagar, Bhavnagar, Rajkot, Jamnagar, Porbandar, Amreli, Junagadh (South West Gujarat)	1%
16	Vadodara city	Bhopal	1%
17	Surendranagar, Bhavnagar, Rajkot, Jamnagar, Porbandar, Amreli, Junagadh (South West Gujarat)	Bhopal	1%
18	Kandla/Mundra/Gandhidham/Bhuj (West Gujarat)	Indore / Dewas	1%
19	Limdi/Jhalod/Kadana/Rest of North Dahod District	Ahmedabad City	1%
20	Halol/Champaner	Indore / Dewas	1%
		Total	**42%**